OSSICULAR EROSION IN CSOM, RECONSTRUCTIVE PROCEDURES AND OUTCOME

Submitted in partial fulfillment of the requirement for the award of the degree of M.S. Branch IV (Otorhinolaryngology)

Department of Otorhinolaryngology
Tirunelveli Medical College
Tirunelveli

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY
CHENNAI – TAMILNADU

APRIL 2015

CERTIFICATE

This is to certify that this dissertation on **"Ossicular Erosion In CSOM, Reconstructive Procedures And Outcome"** presented here in by **Dr. Pratheesh. M.C.** is the original work done in the Department of Otorhinolaryngology, Govt. Tirunelveli Medical College hospital, Tirunelveli in partial fulfillment of regulations of the Tamilnadu Dr. M.G.R. Medical University, Chennai for the award of M.S. (Otorhinolaryngology) under guidance and supervision during the academic year 2012 – 2015.

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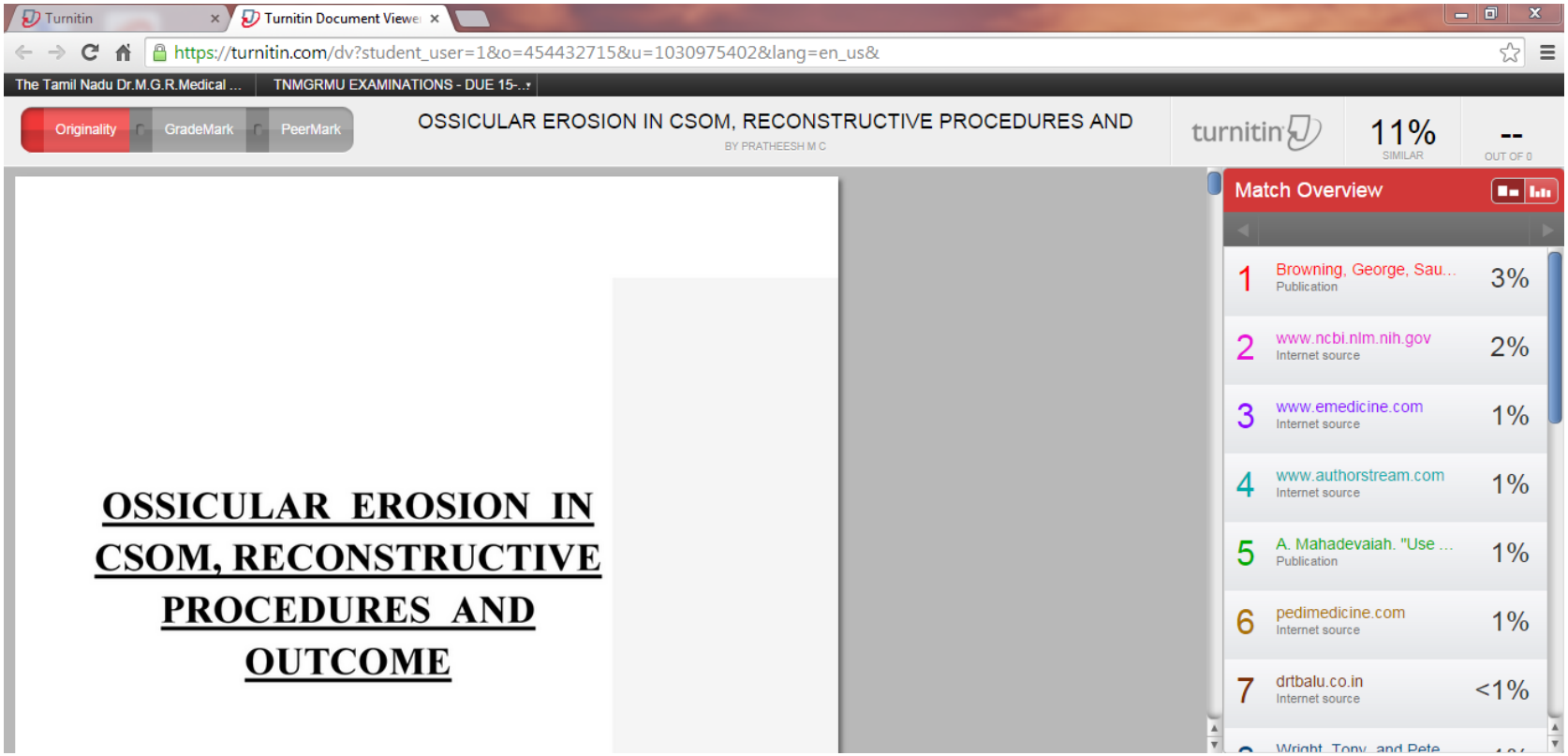
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I Dr. Pratheesh. M.C. solemnly declare that this dissertation, titled **"Ossicular Erosion In CSOM, Reconstructive Procedures And Outcome"** is a bonafide record of work done by me in the department of Otorhinolaryngology, Govt. Tirunelveli Medical College, Tirunelveli under the guidance of Dr. S. Sureshkumar, M.S. D.LO Prof. & HOD of Otorhinolaryngology, Govt. Tirunelveli Medical College, Tirunelveli.

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OSSICULAR EROSION IN CSOM, RECONSTRUCTIVE PROCEDURES AND OUTCOME

INTRODUCTION

Ossiculoplasty may be defined as restoring the hearing mechanism between the tympanic membrane and the oval window by re-establishing a functioning ossicular chain. It is indicated with ossicular discontinuity following erosion, trauma or ossicular fixation due to tympanosclerosis, adhesions etc.

Erosion of ossicles is a common per operative finding while doing surgical management of csom. Type of erosion varies in each patients depending on the pathology of disease and middle ear conditions. It also studies in detail about each ossicular reconstructive procedures in each case and follow up the patient for 3 months and 6 months audiologically and clinically. In the study ,

I have incorporated only reconstructive procedures using the remaining ossicles and conchal cartilages. For reconstruction of tympanic membrane, only temporalis fascia is used in this study. No homografts or alloplasts are used in the study. MERI score and OOPSI are compared with post op follow up and an analysis is made regarding the use of such scores. Audiological improvement is compared in different type of ossicular reconstructions

AIMS & OBJECTIVES

1. To find the incidence of ossicular erosion in csom (mucosal and squamous)
2. To find the incidence of ossicular erosion with respect to each type of perforation of tympanic membrane
3. To find the incidence of various type of perforation in cases of tubotympanic type of csom
4. To study ossicular reconstructive procedures and its audiological outcome
5. To use MERI score & OOPS index in csom cases and analyze the surgical outcome

REVIEW OF LITERATURE

A study was conducted by Nadia Nassif Sarkis and Mohamed Al lackany. They compared results after myringoplasty and Type 1 Tympanoplasty with the use of different graft materials. 250 patients were included in their study. Fascia, perichondrum and cartilage were used in their study. In 110 patients, fascia graft was used. In 50 patients, perichondrial grafts were used in the study. And perichondeal cartilage graft was used in 90 patients. Failure rate was compared as reperforation in the follow up. Failure rate of 7.7% were seen in cartilage graft. 12% failure in perichondreal graft. In cases where fascia graft was used, the reperforation rate was found to be 20%

A study about ossiculoplasty was done by Austin-Kartush. They compared improvement in hearing in patients for whom ossicuplasty was done with another group for whom only myringoplasty was done. 181 patients were included in ossiculoplasty group and 204 patients in myringoplasty group. Their study decided a post op hearing of 10db as success . with such a criteria, success rate was 81% in cases with myringoplasty. But only 55% cases improved after ossiculoplasty. When they reduced the criteria from 10 db to 20 db as success, their results improved. 97% was the success rate in group of myringoplasty. Group of

ossiculoplasty showed a result of 85%.In group of ossiculoplasty, austins classification was done . group A contains 60% cases. Group B with 23%. 8% each in group C and group D. 1% percent does not fall in this classification

In study conducted to identify the prognostic factors that affect surgical outcome in inlay tympanoplasty, Hsu-Huei Weng, MD, MPH, PhD conducted study in 62 patients. Form his study he concluded that only independent factor for the prognosis of surgical outcome is smoking.

In a study to assess hearing results using a titanium ossicular replacement prosthesis, cases for whom canal wall down mastoidectomy patients were included. In long term follow up of these patients, it was concluded that titanium can be used as a satisfactory material for ossiculoplasty

Study about erosion of ossicles in csom cases was done in Himalayan Institute of Medical Sciences, Dehradun. They include a total of 150 patients in their study. Patinets aged more than 16 who were prepared for mastoidectomy was included in this study. In their study, 64% cases were mucosal type where as 36% cases were squamous. 29.78 was the mean age of presentation in this study. 48% were male patients where as 52% were females. In 80.63 percent cases, malleus was found to be intact. On further classifying 97.78% cases of mucosal type of csom cases

had intact malleus.where as malleus was intact only in 55% cases of unsafe csom. Malleus was totally absent in 10% cases. Head alone was eroded in 6.67% cases and all these cases belong to csom squamous type. Handle of malleus was eroded in 2.22% cases of csom mucosal where as in unsafe csom 26.67% cases had handle eroded.

As far as incus is considered, 61.33% cases had intact ossicle. As cases are classified, incus was eroded in 7.77% cases of safe csom where as incus was totally intact only in 15% cases of un safe csom. In unsafe csom, 40% cases had totally absent incus and 35% cases had erosion of long process and lenticular process. Corresponding percentage in safe csom was only 17.33% and 15.33%.

Out of 150 patients, 118(78.67%) cases had intact stapes. 1.11% safe csom had eroded stapes where as 51.67% cases of csom squamous type had eroded stapes

In his study, he included the status of malleo-incudal joint and incudo-stapedial joint. 26% cases had malleo-incudal joint discontinuation. It was more in unsafe type of csom. As far as incudo stapedial joint is evaluated, 38.67% cases had discontinuity. Here also discontinuity was more in unsafe type of csom(85%)

In another study about ossicular erosion , conducted by Mehrnoosh Mousaviagdas, he included166 cases for evaluation. In his study he

concluded that 30.7% erosion of incus partially and 55.4% erosion of incus completely. He concluded that incus is the most common bone eroded in csom cases. In his study, the incidence of erosion of other ossicles were much lower compared to that of incus.

Historical review

Ear diseases and complications have been documented in the early ancient period. In the time of Aristotle, Aesculopius, and Galen, ear diseases were treated with herbs. Surgeries of Pinna and Foreign body removal etc have been documented in the ancient era. Jacapo berengaria da carpi, an anatomist, published "anatomi carpi isgogae" and described two ossicles near tympanic membrane. He also theorised vibration of drum with ossicles .

Andreas Vesalius (1514 – 1564) published de fabrica. He contributed to the world of otorhinolaryngology by naming Malleus and Incus and identifying tensor tympani muscle. He also gave a foresight of existence of stapes. Barthelomeus eustachius(1520-1574) published opercula anatomica and established chorda tympani as a branch of facial nerve & described cochlea with spiral lamina and modiolus . He also made significant contribution to pharyngo tympanic tube(parts, oval shape, course)

Gabriele fallapio (1523-1562) described facial canal,TM, semicircular canal and named stapes. Guichard duverney(1648-1730) published otology's first clinical primer "Craite de I'organe del'ouie". Antonia valsalva (1666-1723) described ankylosis of foot plate and

defined the maneuver by his name. Dominico cotugno(1736-1822) made a dissertation on the fluid of inner ear and its function in transfer of sound.

Sir William Wilde (1815-1876) was the first otologic practitioner who developed instruments(speculum,snare,probe) and identified cone of light. Also he was the first who did I&D for mastoid abscess. Prosper meniere (1799-1862) described the role of inner ear in vertigo. Joseph Toynbee published diseases of ear including cholesteatoma, otosclerosis, etc.

Work on hearing

Alfanso corti made the description of spiral lamina with spiral ganglion &outer and inner hair cells. Ernst reibner described reissners membrane. Hermann von helmholtz described mechanical coupling of sound, and described tonotopic organisation of cochlea.

Von bekesy was the first person who stroboscopically observed travelling waves in cochlea from base to apex.

In Twentieth century

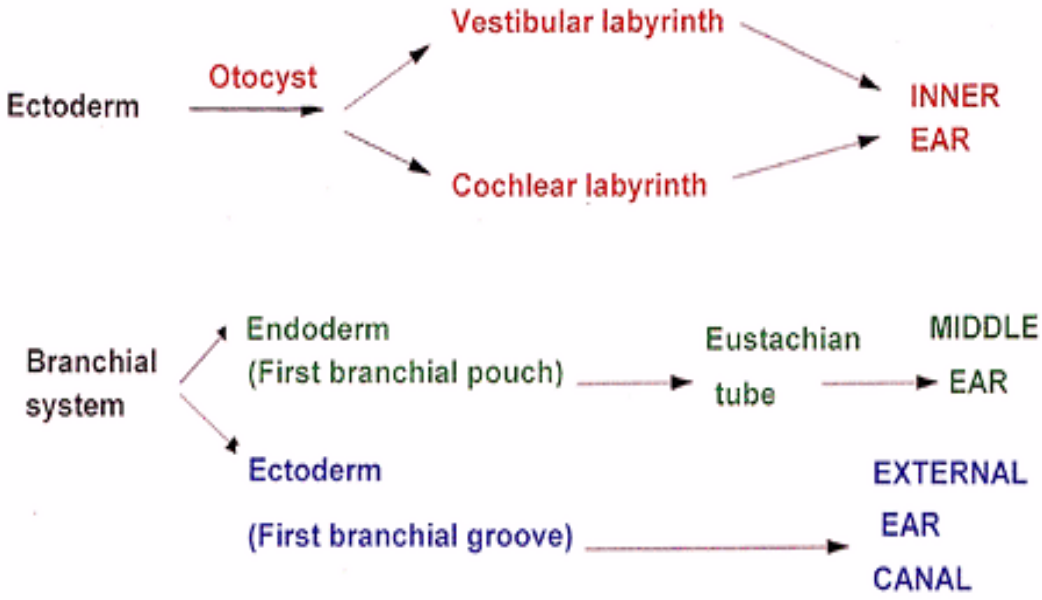
Julius lempert is considered as father of modern otology. He was the first person to use drill in ear surgeries, and described fenestration surgery. George shambaugh was the first to use operating microscope and he contributed to the treatment of otosclerosis.

Zollner and Wullstein introduced tympanoplasty in a systemic form in the early 1950s. Ossicular repositioning was described in 1957. In earlier days , prosthesis made from plastics were used but this practice came to halt when it ended up with higher extrusion rate and stapes footplate fistula. In 1976, Plastipore , an alloplast made from a high density polyethylene sponge was created as a Partial Ossicular replacement Prosthesis and as Total Ossicular Replacement Prosthesis. Ceramics were introduced in 1979. In 1971, Austin presented his classification based on anatomical defects found in ossicular chain. In neuro-otology, William house contributed to cochlear implant surgery. He described translabyrinthine and retosigmoid approach to CP angle

Embryology of middle Ear

Tympanomastoid compartment appears during 3rd week of development . It appears as an outpouch from the 1st pharyngeal pouch and it is called tubotympanic recess. Dorsal end develops as Eustachian tube and tympanic cavity. This pouch expands in the inferior aspect of this cavity and it invades into the surrounding mesenchyme. The terminal end of the 1st pharyngeal pouch differentiate into 4 sacci. They are anticus, posticus, superior and inferior. These sacci surrounds the ossicular chain and lines the whole compartment. Mucosal fold which contains blood vessels are formed by interface between 2 sacci

DEVELOPMENT OF THE EPITHELIAL SYSTEMS OF THE EAR



Traces of development of ossicle are seen as early as 4th week of development. It appears as interbranchial bridge. This connects the upper end of 1st branchial arch(mandibular visceral bar) and middle portion of 2nd branchial arch(hyoid visceral bar). This bridge through cartilaginous differentiation develops to form malleus and incus. Most of the stapes develops from hyoid bar. Exception to this is medial surface of foot plate and annular ligament. These are from otic capsular origin. Ear ossicles attain the adult size by 15th weeks

Anatomy

Middle ear is a 6 walled cavity in the temporal bone and lies between the external and inner ear. It has the form of biconcave disc. It measures about 15 mm from above downwards and 13 mm from behind forwards. Middle ear is very narrow in its transverse diameter . It measures about 6 mm across the upper part, 4 mm in the lower part and 2 mm in its centre and this is the narrowest part. Middle ear cavity has six walls. It consists of medial wall, lateral wall, anterior and posterior wall, roof and floor.

Lateral wall consists of tympanic membrane . Bone above and below the membrane also contributes to lateral wall.

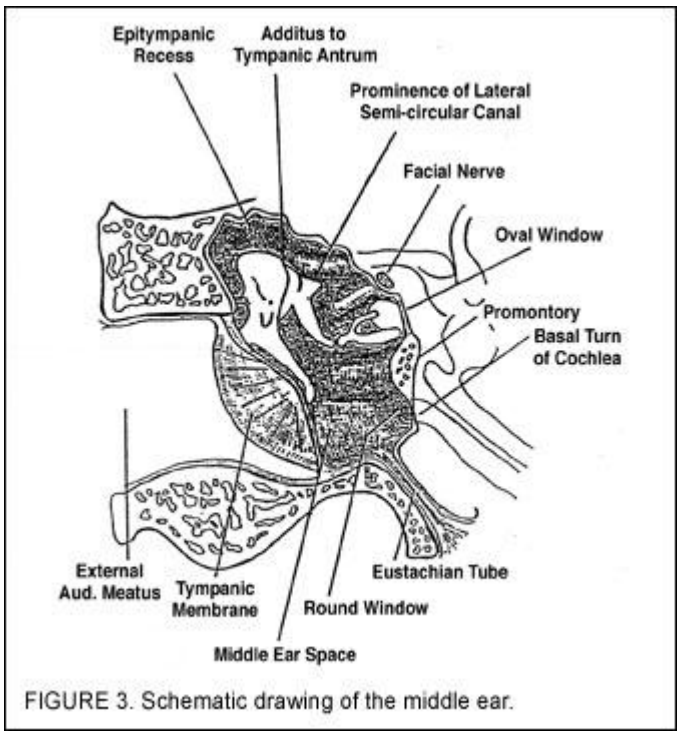
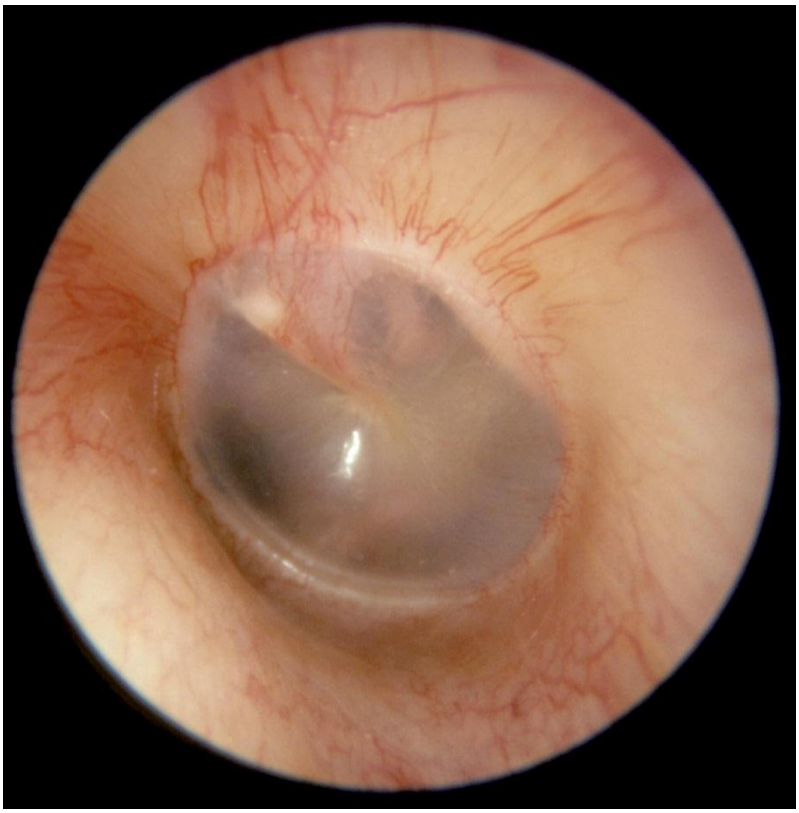


FIGURE 3. Schematic drawing of the middle ear.

Tympanic membrane

Is is an elliptical disc which forms the lateral wall of middle ear. It measures about 10mm high and 8mm from anterior to posterior. It is convex towards the middle ear cavity. The maximum point of convexity is called umbo.

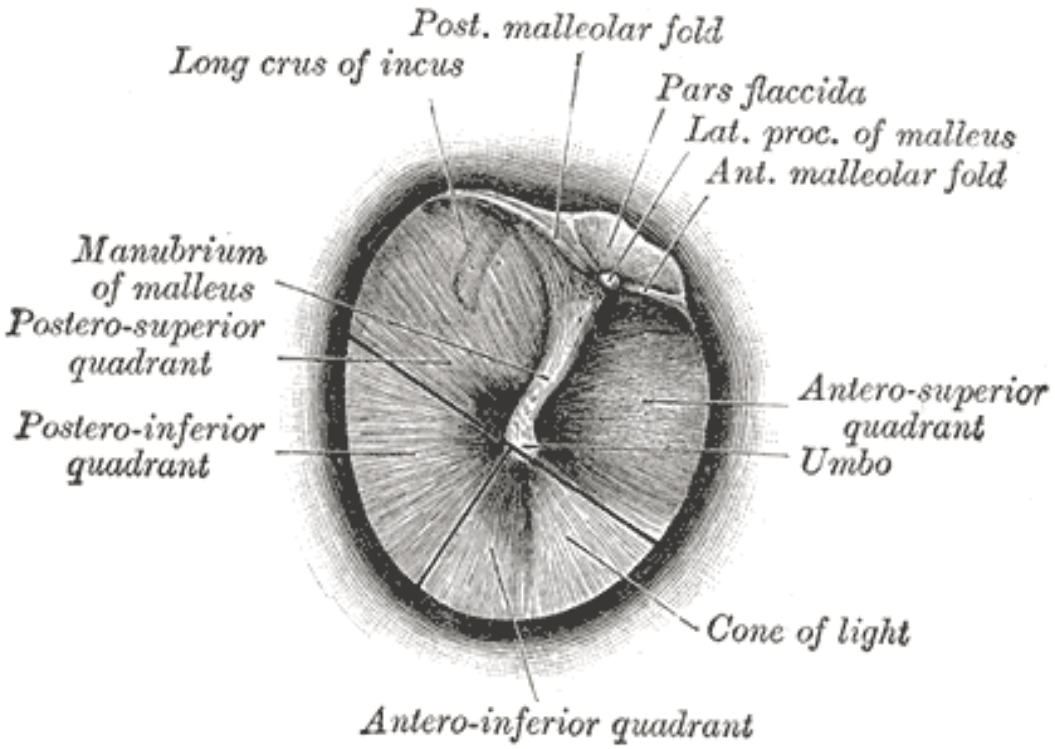


(Above is the picture of tympanic membrane of healthy ear one of our patients posted for surgery for whom opposite ear was prepared)

The tympanic membrane is formed by three layers

1. Outer epithelial layer
2. Middle fibrous layer
3. Inner mucosal layer

Greater part of tympanic membrane is formed by pars tensa which thickens in the periphery to form fibrocartilagenous annulus. This fits into the grooved tympanic sulcus. Tympanic ring is an incomplete circle deficient above and the fibrous layer is absent in the small part of the membrane which occupies the notch of rivinus and it is called pars flaccida. The fibrous annulus is carried from the anterior and posterior extremities of the notch of rivinus to the lateral process of malleus , thus forming anterior and posterior boundaries of pars flaccida.



The membrane is supplied by

1.arteria nutrica malleo-incudei(branch of middle meningeal artery)

2.vascular circle at the periphery formed by

-anterior tympanic artery

-posterior tympanic artery

-tubal twig from the ascending pharyngeal anastomosis

Nerve supply of the tympanic membrane is derived from

- Internally from tympanic plexus
- Externally from auriculo-temporal nerve(branch of trigeminal) supplying anterior half ; and arnold's nerve(branch of vagus) supplying the posterior half

Middle ear cavity is divided into 3 parts

1. Epitympanum
2. Mesotympanum
3. Hypotympanum

Epitympanum

Epitympanum or attic is the space defined superiorly by the tegmen plate, medially by the prominence of horizontal facial canal and ampullary ends of lateral and superior semicircular canals, laterally by scutum, and posteriorly it communicates with antrum through aditus. It houses the head of malleus and body of the incus. A ridge of bone called cog extends inferiorly from the tegmen plate just anterior to the head of malleus. Cog

lies immediately superior to and just slightly posterior to cochleariform process. Cog divides epitympanum into the posterior and anterior epitympanic space. Anterior epitympanic space is also known as supratubal recess. This is a common site for the involvement of attic cholesteatoma. It is often the site for the recurrence . communication of epitympanum to mesotympanum is blocked by ossicles and associated mucosal folds except at 3 air pathways

Mesotymopanum

It consists of posterior tympanum, mesotympanum proper and pro tympanum. Promontory (basilar turn of cochlea) along with oval and round window forms the medial wall of tympanum proper. Jacobson's nerve is a constant landmark in the promontory. this nerve originates form the canaliculus between jugular bulb and carotid artery. It then runs over the promontory to divide into branches near cochleariform process. The main branch passes under this process to supply the attic area. Inferior tympanic artery which is a branch of ascending pharyngeal artery accompanies the Jacobson`s nerve

Protympanum

This contains opening of the bony part of Eustachian tube lying inferior to canal for tensor tympani. Internal carotid artery medial and

inferior to the bony Eustachian tube and is usually covered by a thin plate of bone

Posterior tympanum

It is the site which is commonly involved by cholesteatoma. This divided into 4 sinuses in relation to 2nd genu/vertical segment of facial nerve and pyramidalis process. two sinus lateral to facial nerve are facial recess and lateral sinus. Two sinus medial to facial nerve are posterior tympanic sinus and sinus tympani

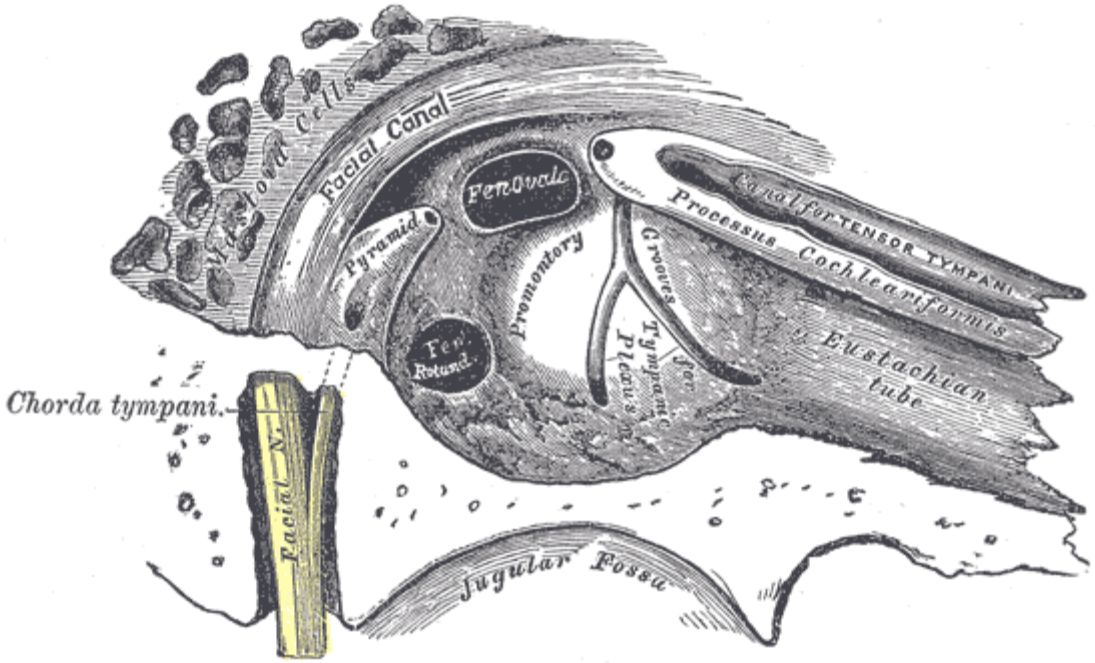
Hypotympanum

This usually consists of a group of air cells inferior to labyrinth and extending anterior to cochlea. This also contains jugular bulb posteriorly and internal carotid artery anteriorly in its medial wall. Jugular bulb and internal carotid artery are separated by a thin plate of bone called jugulocarotid crest or crotch

Medial wall is characterized by the following features

1.promontory

2.fenestra ovale(it lies above and slightly behind the promontory. It measures about 2.5mm by 1.2 mm and has a depth of 3 mm. It opens into vestibule of inner ear)



3. fenestra rotunda (it lies below and behind the promontory. It measures 1.5mm by 1.2 mm. it faces posteriorly. It opens into scala tympani. It is closed by secondary tympanic membrane. The niches of 2 labyrinthine windows communicate at their posterior extremity with a deep recess called sinus tympani

Roof

Roof of the middle ear cavity is formed by tegmen tympani. It separates the middle ear cavity from middle cranial fossa. It is formed partly by the petrous part of temporal bone and partly by the squamous part of temporal bone

Floor

Floor of the middle ear is formed by a thin plate of bone . it separates the middle ear cavity from the jugular bulb.

Anterior wall

-has 4 openings

1.small orifice of canal of Huguier through which the chorda tympani is kept from the middle ear

2.canal of tensor tympani muscle

3.tympanic orifice of Eustachian tube

4.Glaserian fissure which contains tympanic artery and anterior ligament of malleus

Posterior wall consists of an opening which leads backards from the epitympanum into the mastoid antrum. Below this lies the pyramid. This is a small hollow conical projection . the tendon of stapedius muscle emerges through this conical projection. Then the tendon passes forwards to get inserted into the neck of the stapes

Contents of middle ear cavity

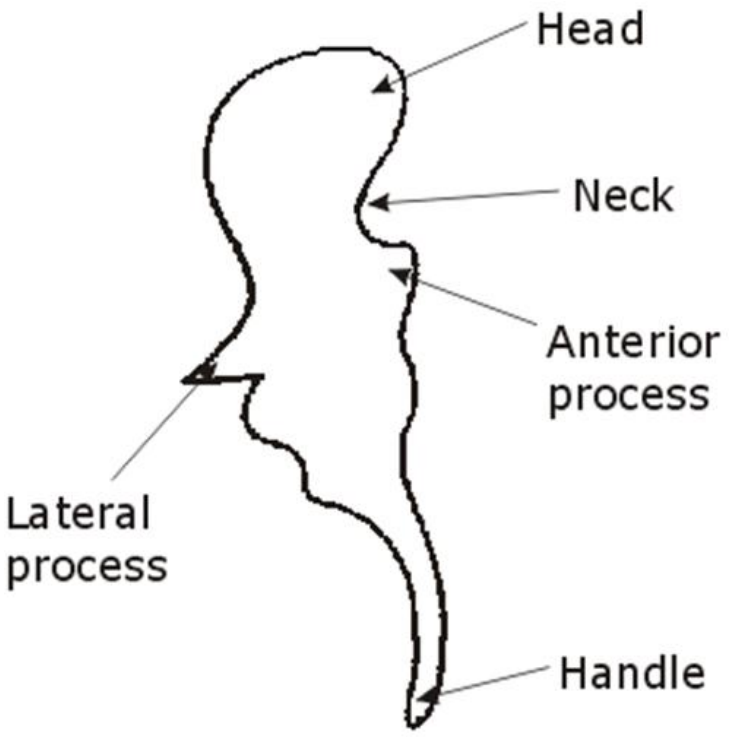
- 3 ossicles
- 2 muscles (tensor tympani & stapedius)
- 1 nerve (chorda tympani)
- Air & tympanic plexus

Ear ossicles

Ear ossicles derieve their names from the blacksmith's forge. They are 1. Malleus(hammer) 2. Incus(anvil) 3. Stapes(stirrup)

Malleus

Malleus is the largest ossicle. It is 7.5-8 mm in length. Parts of malleus are head, neck, anterior and lateral process, handle of malleus. Head is in the attic and it articulates with the body of incus. The anterior ligament of the malleus is attached to its anterior process.

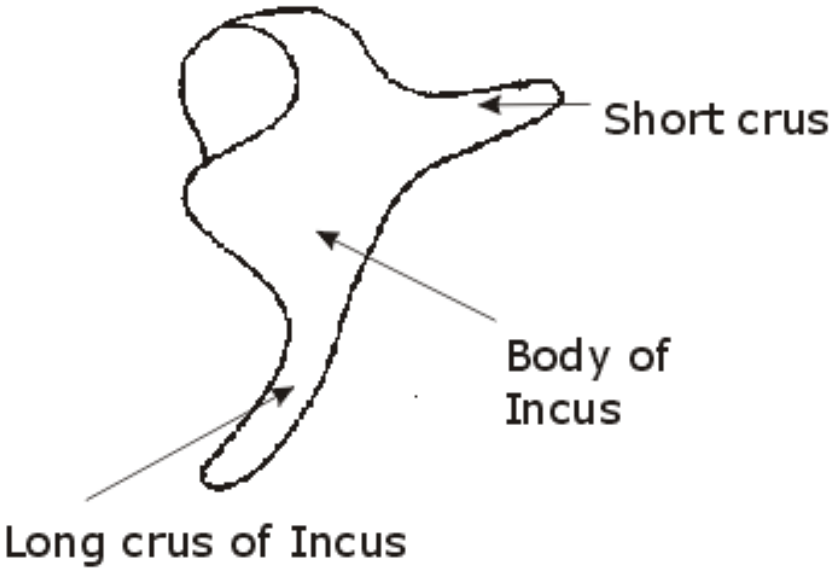


The handle of the malleus directed downwards and slightly backwards and is firmly attached to the middle fibrous layer of the tympanic membrane . The malleus is suspended by an anterior ligament, a

superior ligament attached to the tegmen tympani and a lateral ligament between its lateral process and the margins of the notch of rivinus

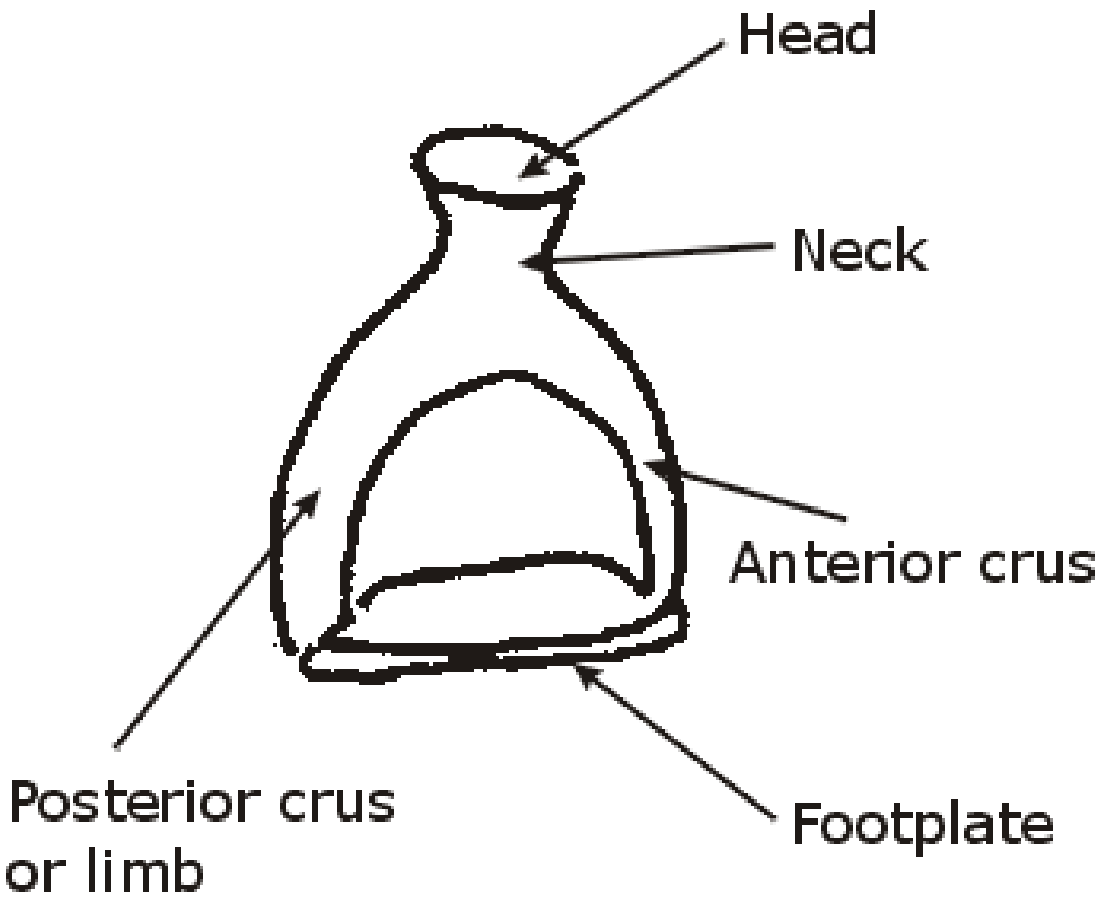
Incus

Incus measures about 6mm*6mm. It resembles a bicuspid tooth and its body articulates with the head of the malleus. This lies in the attic, as does the short process to which the ligament of incus is attached.



The long process of the incus descends behind the handle of malleusand parallel to it. At its lower end there is a very small medially directed lenticular process, which articulates with the head of stapes. The length of the long process is rather more than one half of that of the handle of the malleus

Stapes



Stapes is the smallest bone in the body. It has a head and a neck, anterior and posterior crura and a footplate which is held in the oval window by the annular ligament. The stapedius tendon is inserted into the posterior surface of the neck. Superior surface of the footplate is convex, where as the inferior margin is relatively straight, occasionally concave, thus giving the base a reniform outline Intratympanic muscles

1.Tensor tympani muscle

Long bipinnate muscle. It runs for 12 mm above the Eustachian tube. This muscle arises mainly from the bony tunnel above the osseous

part of the tube. It then passes backwards and laterally through this tunnel. It gets inserted into the medical surface of malleus just below its neck. This muscle is innervated by a branch of fifth cranial nerve

2. Stapedius muscle

It's a short bulky muscle. This occupies the pyramid and the canal. It is supplied by the branch of 7^{th} cranial nerve. The actions of the intratympanic muscles are controlled reflexly and it is thought that they protect the inner ear against the harmful effects of the loud sound

Chorda tympani

Chief nerve of taste, is a branch of facial nerve and it arises in the fallopian canal at a variable distance above the stylomastoid foramen. It enters the middle ear cavity through its posterior wall, lateral to pyramid and escapes the middle ear through canal of Huguier. It is carried to the medial end of the squamotympanic fissure and passes downwards and forwards to join the lingual nerve. It also contains parasympathetic secretory fibres which are relayed to the submandibular and sublingual salivary glands through the submandibular ganglion

Tympanic plexus

Derived from tympanic nerve(branch of glossopharyngeal nerve) and contributions from caroticotympanic nerves(arises in the carotid canal from the sympathetic plexus around the internal carotid artery

Aditus and antrum

Upper attic space of epitympanum leads back to aditus and antrum. The bony prominence of the horizontal semicircular canal lies between its medial wall and its floor. The facial nerve lies on a plane below and deepto the opening of the aditus

Mastoid antrum

It is an air chamber located in the temporal bone. Its lining mucosa is simple epithelium made of single row of flattened squamous cells. In adults , it measures about 14mm from front to back, 9mm from top to bottom, and 7 mm from side to side. Its medial wall is related to posterior and horizontal semicircular canals. Lateral portion is formed by squamous portion of temporal bone. Macewen's triangle forms the surface marking to mastoid antrum. Its floor and posterior wall is formed by mastoid part of temporal bone

Mastoid process

"Mastos meaning breast and eidos meaning resemblance"

There is no actual process at birth.development of mastoid process is depending entirely on development of sternomastoid muscle.

Mucous Membrane of middle ear

A thin delicate mucous membrane lines the whole of the middle ear and is reflected on to the ossicles and tendon of the intratympanic muscles. In general it consists of single non-ciliated cuboidal epithelium without a basement membrane but it may be simple or columnar near the Eustachian tube and in hypotympanum. As we follow the mucous membrane back to mastoid antrum ,it becomes single row of flattened squamous cells

Table 1. Middle-Ear Defense Mechanisms That Act Against Bacterial Colonization

Mucin
Physical barrier of the mucus
Substances that kill bacteria or inhibit their growth (lysozyme, lactoferrin, lactoperoxidase)
Substances that prevent adherence of the bacteria to the epithelial wall (sialic acid–containing oligosaccharides)
Ciliary function
Epithelial defense system
Rapidly dividing mucosal cells
Superficial specific mucosal immune system (secretory antibodies: secretory IgA)
Lamina propria defense systems
Nonspecific (complement, phagocytes, transferrin)
Specific (antibodies, T cells)

Blood supply

Blood supply to tympanic cavity is derived from numerous sources and they are small and they travel through dense bone.

Anterior region of the tympanic cavity is supplied by (a) anterior tympanic artery- branch of internal maxillary artery

(b)ramus tympanici – branch of internal carotid artery

Posterior region is supplied by posterior tympanic artery, a branch of mastoid artery(branch of stylomastoid artery). Superior region is supplied by 3 branches of middle meningeal artery. They are

1.superficial petrosal artery

2.superior tympanic artery

3.ramus nutricia incudomallei

The inferior region is supplied by inferior tympanic artery which is a branch of ascending pharyngeal artery

The malleus and incus is partly supplied by ramus nutricia incudomallei, a branch of middle meningeal artery. The malleus also receives a branch from the anterior tympanic artery. According to Nager and Nager(1953), the incus is also supplied by the incudal artery, another branch of anterior tympanic artery. This artery enters middle ear through petro-tympanic fissure and enters the body of incus in its lateral side.

Inside the body , the artery forms a vascular network which gives branches supplying the short and long process. There is a vascular network around the incudo-stapedial joint which is supplied by branches of the superior and inferior tympanic arteries

Stapes is supplied by 2 group of vessels : the first which is concerned mainly with supplying the footplate and crura; is derieved fro the anterior tympanic artery and the plexus surrounding the facial nerve posteriorly. Second group which supplies the apex of the crura, the head and neck of stapes, the incudostapedial joint arises from the plexus which surrounds the facial nerve and emerges into the tympanum near the pyramid. Both group of stapedial vessels anastamose on the neck of the stapes, the conjoined vessels , then passing over the incudostapedial joint, to supply it by means of incomplete proximal and distal arterial circles

Nerve supply of middle ear

Sensory nerve supply to the middle ear cavity is supplied by tympanic plexus. Tensor tympani is supplied by the branch of mandibular nerve. Stapedius muscle is supplied by a branch of facial nerve

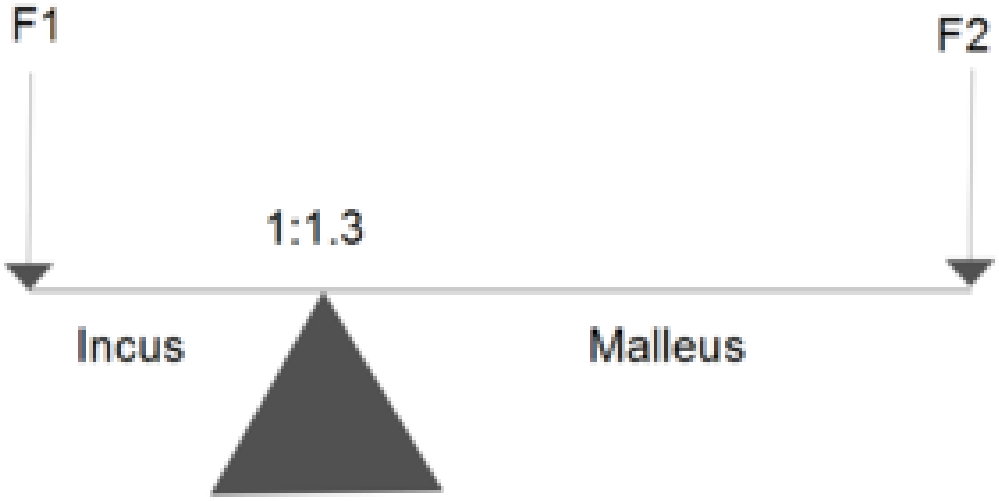
PHYSIOLOGY OF SOUND CONDUCTION

Pinna functions as a sound collector and also helps in locating the sound source. The acoustic functions of the external meatus is to permit air-borne sound waves to reach the tympanic membrane

Tympanic membrane lever

Anatomy of the tympanic membrane and bony tympanic annulus provide a mechanical advantage. The tympanic membrane is a tense surface formed by the fibres of the tympanic membrane, which are tightly stretched over the malleus. Sound energy is directed towards the center of the tympanic membrane so that the manubrium receives the greatest amount. This creates amplification of the energy and provides at least a twofold gain in sound pressure at the malleus

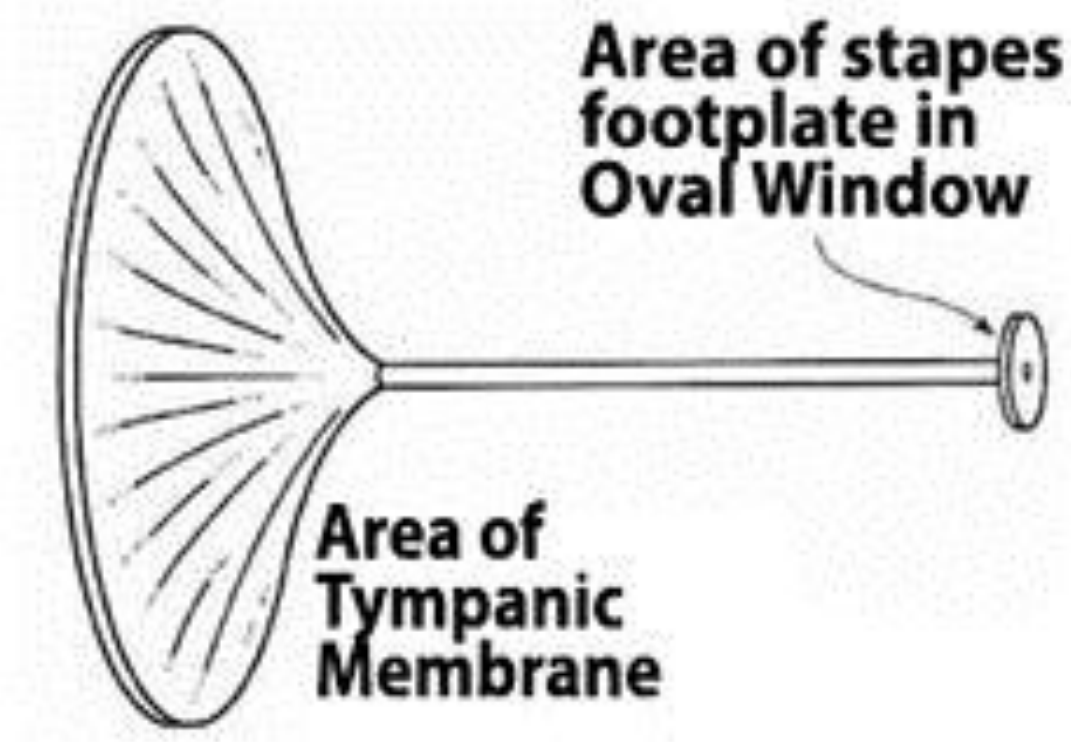
Ossicular lever



Lever Principle For Malleus and Incus

The anatomy of the ossicles lends itself to another mechanical advantage. The malleus and incus work as a unit, but the manubrium is 1.3 times longer than the long process of incus. This provides a lever action ratio of 1.3 to 1 as sound energy is transferred

Hydraulic lever



The anatomy of the middle ear also lends itself to the third lever, the hydraulic lever. The area of the tympanic membrane is considerably larger than the area of the stapes footplate. Sound pressure collected over the area of the tympanic membrane and transmitted to the area of the smaller area of footplate results in an increase in force proportional to the ratio of the areas.

CSOM

CSOM is defined as chronic inflammation of middle ear cleft, which includes middle ear, attic, aditus, antrum and Eustachian tube. The term CSOM is replaced now by COM.There are two types of CSOM. Mucosal/Tubotympanic (safe CSOM) and squamous/atticoantral (unsafe CSOM). Both are further classified as active and inactive. In both type of CSOM, ossicular erosion occus. This propensity for ossicular destruction is much greater in cases of unsafe CSOM, due to the presence of cholesteatoma and/or granulations. The mechanism proposed for erosion in chronic middle ear inflammation is overproduction of cytokines—TNF alpha, interleukin-2, fibroblast growth factor(FGF), and platelet derived growth factor(PDGF), which promote hypervascularisation, osteoclast activation and bone resorption causing ossicular damage. TNF-alpha also produces neovascularisation and hence granulation tissue formation. This inflammatory process in the middle ear is more harmful the longer it stays and the nearer it is to the ossicular chain. Pathologies that interrupt the ossicular chain result in large hearing losses. Complete disruption of the ossicular chain can result upto 60 dB hearing loss

Pathology

Inactive mucosal COM

In these cases, there is a permanent perforation. Perforation is confined to pars tensa. Here mucosa of middle ear and mastoid is normal and is not inflamed. A remnant of tympanic membrane will be there surrounding the perforation completely. At the margin of these perforation, mucocutaneous junction is seen.

Active mucosal COM

These are cases with perforation with otorrhoea. There wil be chronic inflammation in the middle ear mucosa and mastoid mucosa. There wil be varying degree of oedema, hypervascularity, submucosal fibrosis. Also infiltration of these mucosa by plasma cells, lymphocytes and histiocytes is seen. Some areas of ulceration can be seen in these mucosa. Along with ulceration, there will be proliferation of blood vessels, fibroblasts and inflammatory cells. These mucosal changes may some times progress and coalesce to form aural polyp.

Such active mucosal COM wil be associated with resorption of parts or all of the ossicular chain called resorptive osteitis. Such ossicular erosion on histopathology will show hyperemic along with proliferation of capillaries and prominent histiocytes. Generally the order of ossicular erosion is long process of incus > stapes crura > body of incus >

manubrium. Scott brown edition 7 says reason for these ossicular erosion is more due to their delicate structures and location rather than their tenuous blood supply

Inactive squamous COM

Negative static middle ear pressure can result in retraction of the tympanic membrane . A retraction pocket consists of an invagination of tympanic membrane into the middle ear space. It may be fixed when it is adherent to any middle ear structures. It may be free when it can move medially and laterally depending on the state of inflation of the middle ear. A more advanced type of retraction is called epidermization. It is defined as replacement of middle ear mucosa by keratinisng squamous epithelium without retention of keratin debris. Epidermization often remains quiescent and does not progress to cholesteatoma or active suppuration

Active squamous COM(cholesteatoma)

Histologically the correct term for cholesteatoma will be "keratoma".

Histologically it is squamous epithelial lining or matrix of a cholesteatoma . The matrix is usually surrounded by a layer of inflamed vascular subepithelial connective tissue. Cholesteatoma is potentially dangerous because of its potential to incite resorption of bone leading to intratemporal or intracranial complications

Healed COM

It is otherwise called as dimeric membrane . It is loss of lamina propria of the tympanic membrane due to atrophy or failure to reform during healing of the perforation. Such a thin membrane is prone to retraction if there is negative static middle ear pressure

Aetiology of COM

1. Acute otitis media and otitis media with effusion – these can produce long term changes of the tympanic membrane. these changes can reduce the elastic properties of the tympanic membrane, making it more susceptible to chronic perforation or retraction
2. Genetics and race – highest in eskimos, native americans , new Zealand maoris and Australian aborigines
3. Environment – higher in lower socioeconomic groups
4. Eustachain tube function
5. Gastro – esophageal reflux
6. Craniofacial abnormalities – incidence of COM in cleft palate is high
7. Autoimmune disease
8. immunodeficiency

Surgical pathology

Tympanic membrane graft

Commonly used grafts includes autologous temporalis fascia, perichondrium, cartilage and adipose tissue. Histologically tympanic membrane grafts become lined by squamous epitheliumon the ear canal side and middle ear mucosa on the tympanic cavity side. Graft itself becomes the middle or connective tissue portion of the reconstructed drum, but the orderly arrangement of concentric and radial collagen fibres as seen in the normal drum

Myringoplasty

Myringoplasty is defined as closure of any drum perforation. It can be part of a major reconstruction of the entire middle ear and ear canal or part of a tympanoplasty with ossicular reconstruction, or , only a repair of a perforation, without any work in the tympanic cavity

Classification of perforation

Anatomically pars tensa is divided into 4 quadrants, the posterosuperior, anterosuperior, posteroinferior and anteroinferior. Perforation could possibly be classified in relation to the 4 quadrants , but only small perforation are located exclusively on one of the quadrants. The vast majority of perforations in chronic otitis media especially medium sized and large perforations , usually border on , or involve, the neighbouring quadrants , making the description of perforation in terms of quadrants complicated. Over the years , now tympanic membrane perforations are classified as

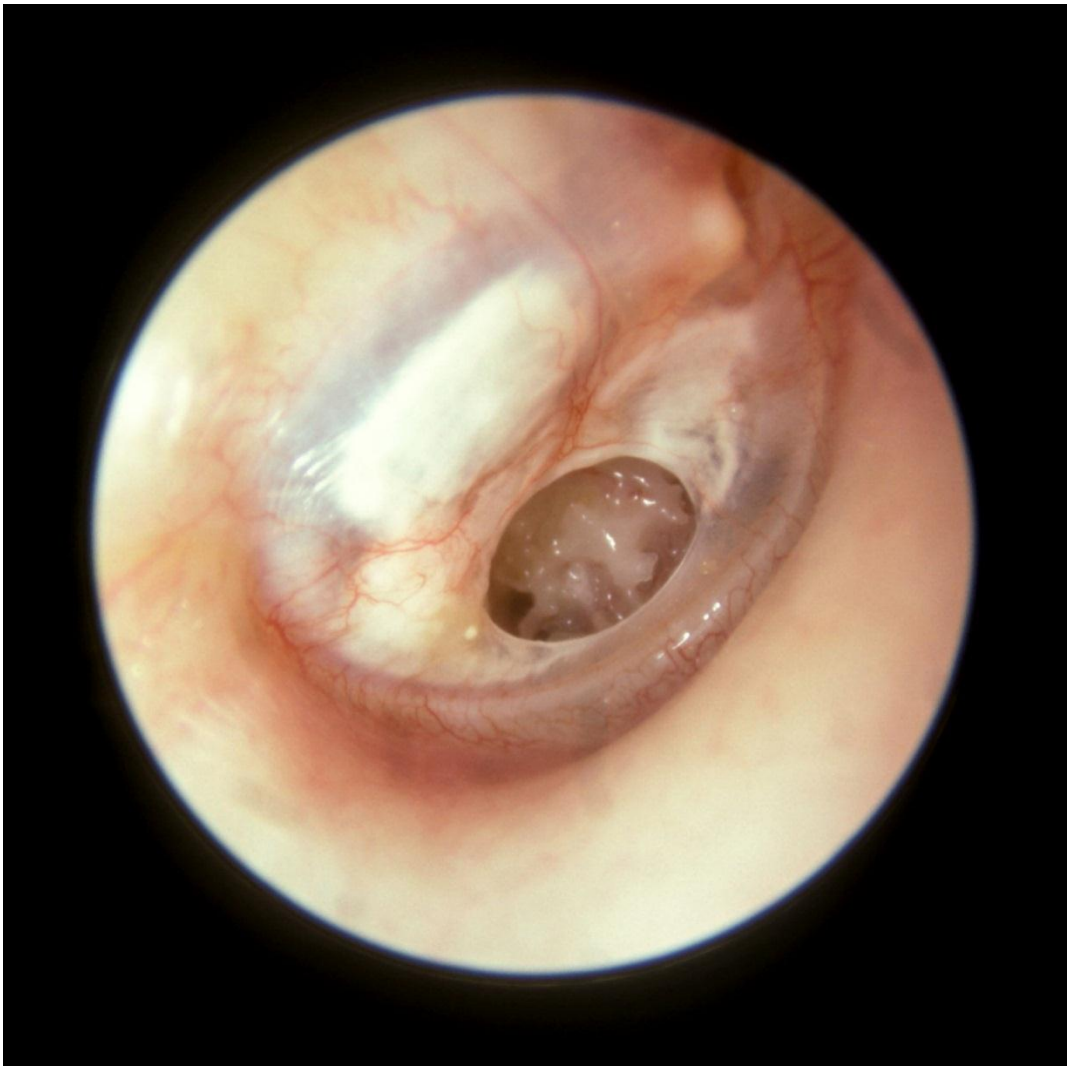
1.anterior

2. inferior

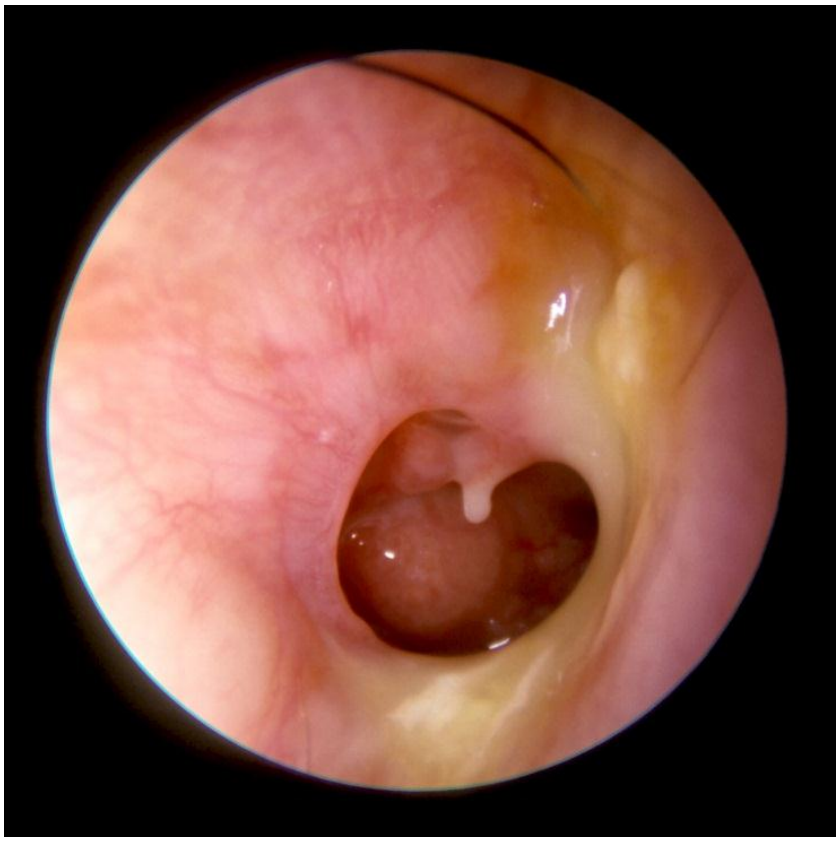
3. posterior

4. total or subtotal perforation

Here are few pictures of tympanic membrane perforations of cases that's included in the study.



Anterior perforation can extend inferiorly , so as a posterior perforation. A large inferior perforation can extend superiorly, involving anterosuperiorly and posterosuperiorly and becomes a subtotal perforation. Techniques used to treat subtotal perforations are usually same as that of a total perforation



Attic perforation

General principles of myringoplasty

1.Keratinized squamous epithelium should be removed from edges of the perforation. This can be achieved either by

a.excision of the perforation edge

b.excision of major part of the drum remnant

c. dissection of the squamous keratinized epithelium from the edges

2. No remnants of keratinized epithelium should be left between the graft and the outer surface of the drum remnant in onlay technique, and between the graft and the under surface of the drum remnant in underlay technique

3. The size of the graft should be carefully fitted to the deepitheliased area of the drum, and should not overlap the keratinized epithelium. This problem is seen only in onlay techniques

4. The graft shiuld have firm contactwith the under sureface of the drum, either by suspension to the drum remnant using special measures or by pressing it up under the drum remnant with solid gelfoam packing of the tympanic cavity

Office chemical myringoplasty

Introduced by Roosa in 1876. This technique was popularized by Derlacki in early 1950s. This technique is used in cooperative patients with small perforation. Perforation of size less than 4 mm is managed by this.

Contraindications for this procedure

1. Small ear canal
2. Marginal perforation
3. Active infection
4. Presence of cholesteatoma
5. Any conductive hearing loss due to ossicular problem
6. Presence of extensive tympanosclerosis

In the procedure , under the microscope, the edges of the perforation are cauterized with trichloroacetic acid. It is applied by a metallic applicator with a small amount of cotton wound tightly at its tip. Chemical cauterization destroys the squamous epithelium that has grown over the rim of the perforation. This causes exposure of fibroblasts and promotes healing of lamina propria. Another alternative chemical agent is silver nitrate. The procedure is repeated after 2 weeks

Approaches

1. Transcanal myringoplasty
2. Post-aural myringoplasty

Surgical technique

Trans canal myringoplasty

1. Harvesting temporalis fascia or any other fascia planned for myringoplasty
2. Transcanal exposure
3. Freshening the margins of perforation
4. Canal incisions and elevation of tympanomeatal flap
5. Assessment of ossicular chain
6. Preparation of graft bed
7. Graft placement

8. Closure of wound

Post-aural myringoplasty

1. Canal incision and elevation of posterior meatal skin flap
2. Post aural incision
3. Harvesting the fascia
4. Subcutaneous tissue incision and exposure of middle ear
5. Scrapping of mucosa under the remnant tympanic membrane and freshening the margins of perforation
6. Anterior window
7. Superior and inferior tympanomeatal incision
8. Elevation of anteriorly based tympanomeatal flap
9. Skeletanizing of malleus handle
10. Assessment of ossicular chain
11. Preparation of graft bed
12. Underlay fascia grafting with exteriorizing malleus handle
13. Repositioning of posterior meatal skin flap
14. Closure of wound

Tympanoplasty

Tympanoplasty is defined as reconstruction of tympanic membrane along with clearance of middle ear pathology

There are 2 common tympanoplasty techniques

1. Underlay technique
2. Overlay technique

   Underlay technique is otherwise called as medial grafting where as overlay technique is called lateral grafting

Underlay technique

Approaches

1.postaural approach

2.transcanal approach

Advantages

1. technically easy
2. useful in small perforation
3. useful in easily visualized perforation

Disadvantages

1. anterior meatal recess cant be visualized easily
2. middle ear volume is reduced

Overlay technique

Excellent exposure of anterior recess is an advantage of overlay technique. Also high success rate is observed in this technique because the drum is replaced intact at the end of the procedure.

Disadvantage

1. lateralization of the graft
2. technically difficult
3. delayed healing

Tympanoplasty without mastoidectomy

Indications

1. Dry central perforation associated with ossicular necrosis
2. Post traumatic perforation with ossicular discontinuity
3. Congenital ossicular discontinuity

Tympanoplasty with cortical mastoidectomy

Indications

1. Resistant chronic otitis media with persistant discharge not responding to medical line of treatment with intact ossicular chain or ossicular necrosis with different sizes of perforation or when the middle ear mucosa appears abnormal

2. Posterior marginal perforation with retraction of tympanic membrane with ossicular necrosis or discontinuity
3. Atelactic or adhesive otitis media or tympanosclerosis

Classification of tympanoplasty

Farrier's classification

Tympanoplasty type 1

Done in cases with intact ossicles

Tympanoplasty type 2

Reconstruction of a new eardrum placed in contact with a normal mobile incus in cases with a missing malleus handle,

Tympanoplasty type 3

Interposition of a bone graft between the intact stapes and the drum or the malleus handle

Tympanoplasty type 4

Reconstruction by a columella in cases with a missing stapedeal arch

Tympanoplasty type 5

Fenestration of the lateral semicircular canal

Tympanoplasty type 6

Myringoplasty in cases with no ossiculoplasty and no restoration of the hearing

Wullstein's classification

Type 1 – Done in cases with intact ossicles

Type 2 – Done in cases with defective or absent malleus but intact incudostapedial joint. The fascia is placed on the lenticular process of the incus

Type 3 – Myringostapediopexy

Type 4 – Cases where malleus incus and stapes suprastructure are absent and only footplate is left

Type 5 – cases where all the ossicles are absent. A new fenestra is created in lateral semicircular canal

Austin's classification

Classification was made on 1971 based on the presence /absence of malleus and presence/absence of stapes suprastructure. Here we are considering incus as eroded. Four types are :

Type A: M+S+

This involves the presence of both malleus and stapes suprastructure and requires reconstruction of tympanic membrane and reconstruction

between stapes head and handle of malleus or neo tympanum. This is the most common ossicular defect

Type B: M-S+

This involves the absence of malleus and presence of stapes suprastructure and requires the reconstruction of tympanic membrane, malleus and incus and reconstruction is performed between stapes head and neo tympanic membrane

Type C: M+S-

This involves the presence of malleus but absence of stapes suprastructure and requires reconstruction of tympanic membrane and reconstruction of ossicular chain is performed between stapes footplate and malleus handle or neo tympanic membrane

Type D: M-S-

It involves the absence of both malleus handle and stapes suprastructure requiring reconstruction of tympanic membrane , malleus , incus and stapes suprastructure. Reconstruction of ossicular chain is performed between stapes footplate and neotympanic membrane

Other rare ossicular defects include isolated absence of malleus handle, isolated absence of stapes suprastructure, fixed stapes with

presence of malleus handle and incus, fixed stapes with absence of malleus handle and incus and dehiscence of stapes footplate

Requirements for primary ossiculoplasty

1. Presence of normal or minimally hypertrophied middle ear mucosa
2. Diseased middle ear mucosa over promontory is removed, but normal or hypertrophied mucosa at the Eustachian tube orifice and hypotympanic area
3. Patent Eustachian tube function
4. Mobile stapes footplate

Contraindications for primary ossiculoplasty

Absolute – only hearing ear

Relative –

1. Mixed hearing loss with lower bone conduction than the contralateral ear
2. Spontaneous myringostapediopexy with good hearing
3. Severe atelectasis

.

Reasons for ossicular reconstruction failures

1. Recurrent or residual middle ear disease

2. Eustachian tube dysfunction

3. Prosthesis extrusion(improper size/ design flaw)

4. Prosthesis movement (at lateral connection/ medial connection)

Considerations for ideal prosthesis

1.size

2.shape

3.material

4.weight

5.cost

6.easily modified

Autografts

Autograft material such as cartilage and bone are used. Studeis have shown that cartilage unstable, loses rigidity and resorption occurs . Autologous malleus and incus grafts demonstrated noevidence of bone erosion and little resorption

Disadvantages

1.prolonged operative time to obtain and shape the material

2.possible lack of availability in chronically diseased ear and revision cases

3.Possible resorption

4.loss of rigidity

5.new bone formation and revascularization

Homografts

Irradiated homograft ossicles and cartilage were introduced in 1960 Now a days , its rarely used because of the risk of disease transmission

Alloplasts

They are readily available, presculpted and free from infectious diseases They include polyethylene tubing, teflon, silastic tubing, stainless stell, titanium, gold, high density polyethylene sponge (HDPS), bioglass, bioceramics

Disadvantage

Lack of biocompatibility-leading to high incidence of extrusion

Short columella ossiculoplasty/Myringostapediopexy

Absence of incus and presence of stapes suprastructure irrespective of malleus handle (M+/-,I-,SS+) is the most common ossiculoplasty situation. When such a reconstruction is made between stapes suprastructure and malleus, the procedure is called transposition technique. Sometimes, this technique becomes difficult as malleus handle has varied position.

The necrotised incus is removed and meticulous clearance of middle ear is attained along with mastoidectomy. Ossicle is held in position using ossicle holding forceps and drilling is done using 0.6mm diamond burr. Part of the short process is removed while keeping about 5mm length of incus body for contact with the neo-tympanic membrane.

The superior surface of body of incus is converted to a slanting surface so that a wide contact area is available between the ossicle graft and fascia graft. The remnant long process is drilled to make it cylindrical in shape with its base flat. A socket is drilled in undersurface of remodelled long process under higher magnification using the same 0.6mm diamond burr for engaging the head of the stapes.

A groove is made in the socket for accommodating the stapedius tendon. The remodelled graft is placed over stapes head and temporarily

stabilized by gelfoam and fascia graft placed along with repositioning of tympanomeatal flap

Precautions

1. length of the prosthesis should be checked . If length is more, it wil be projecting too much. Similarly if length of the ossicle is too short, ossiculoplasty wil be unstable
2. depth of the socket should be adequate. Too shallow socket will lead to displacement of prosthesis. Deep socket may cause the graft to come in contact with promontory or facial canal
3. articular surface of incus should be facing superiorly so that the slant over the incus coincides with the slope of healed tympanic membrane

Long columella ossiculoplasty/myringoplatinopexy

Absence of stapes suprastructure and incus with or without malleus(M+/-,I-,SS-)is supposed to be the most difficult reconstructive problem and we proceed with long columella ossiculoplasty or transposition technique using malleus or neomalleus or class wullstein type 4 tympanoplasty

After meticulous clearance of middle ear disease by intact canal wall or canal wall down mastoidectomy. Remnant incus is removed and malleus if present is separated from tympanomaetal flap using sharp dissection.

Malleus is held in position and head is slightly flattened using a short 0.6mm diamond burr and converted to a slanting surface with wide surface contact area with slope upwards when the articular surface is facing superiorly. Malleus handle below the level of lateral process is removed. The anterior process of malleus is drilled off. The inferior surface is given the shape of a boot, with its size slightly smaller than the size of footplate.

A small piece of temporalis fascia is kept over the footplate so that the new ossicle graft wil not develop bony ankylosis with the footplate. The shaped ossicle is placed between footplate and neotympanic membrane. Fascia graft is positioned and tympanomeatal flap is repositioned

Guidelines for successful ossiculoplasty

1. one stage ossiculoplasty should be carried out in all possible cases
2. procedure should be staged if indicated
3. undersurface temporalis fascia grafting is essential for undisturbed healing of the tympanic membrane and the stability of the graft
4. proper sculpturing of the ossicle and cartilage tip

MATERIALS AND METHODS

Hearing is one of the primary senses in human being. Although its not a life threatening condition, hearing loss can affect tremendously in daily life and it should not be underestimated. It can have social as well as personal limitations . A complaint of hard of hearing thus should not be ignored

Study setting

This was a prospective study, conducted in department of otorhinolaryngology , Tirunelveli medical college hospital, Tirunelveli

Study duration

This study was carried out during March 2013 to September 2014

Study design

Prospective study conducted for one and half years of duration

Study population - Patients prepared for surgical management for chronic suppurative otitis media in the department of otorhinolaryngology, Tirunelveli Medical College Hospital, Tirunelveli during this study period

164 such patients are included in my study

Method of data collection

The profoma was designed based on objective of the study. According to the proforma, detailed history was taken . then thorough ENT and systemic examination was done. The ears were examined by otoscopy initially and otoendoscope to establish a preoperative diagnosis of safe or unsafe disease .All patients underwent a preoperative pure tone audiometry, to find out the hearing status and obtain documentary evidence for the same, and X-ray mastoid (bilateral Schueller's view) to assess the pathology and surgical anatomy of the mastoid. CT temporal bone was also taken for preop evaluation.Per operatively, tympanic membrane findings and middle ear findings like granulations, ossicle status, ossicular mobility, middle ear mucosa, Eustachian tube, etc were noted . ossiculoplasty methods were noted and documented. In my study, only underlay technique is done . no allograft was used in the study. Only temporalis fascia was used as graft for tympanic membrane reconstruction. Patient was discharged after advising about a 3^{rd} month and 6^{th} month follow up. During the follow up, patient was subjected to otoendoscopic and audiological evaluation and it was documented

Analysis of data

Data thus collected was analysed and presented in the form of figures, tables, pie charts, etc. inferences were made based on the analysis. Pre op and 3rd and 6th month follow up datas were cross analyzed. In each type of surgery, pre op audiogram mean value of patients is taken and is compared to mean post op audiology on 3rd and 6th month visit and mean difference is measured to assess the audiological outcome in each type of surgery. Like wise the mean difference is assessed in each type of perforation .otoscopic assessment is also compared in each type of perforation, this helps us to conclude a pattern in ossicular erosion and pre occupy our mind about the ossicular status, audiological outcome even before we start our preparation and surgery

Inclusion Criteria

1.All cases of csom who underwent surgery in the department of ENT in Tirunelveli medical college

Exclusion Criteria

1.History of previous mastoidectomy

2.History of previous stapedotomy or stapedectomy

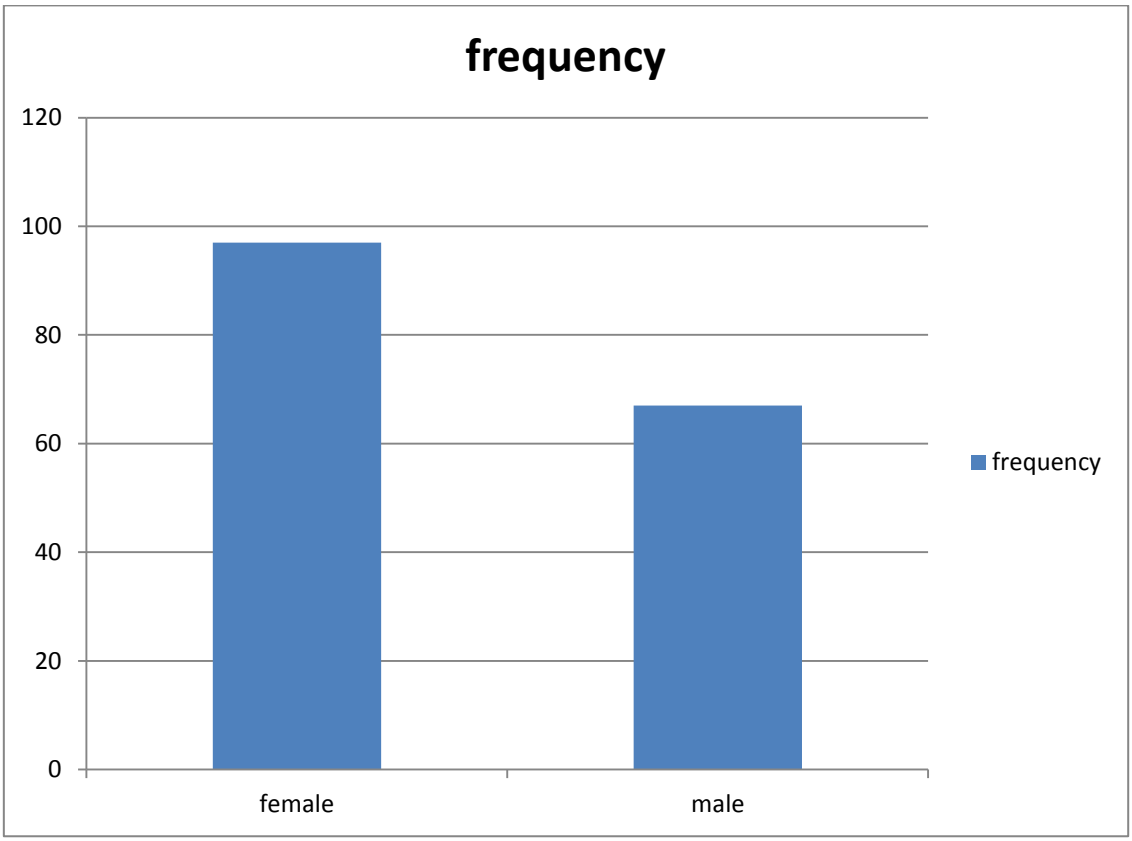
3.Malignancy of middle ear

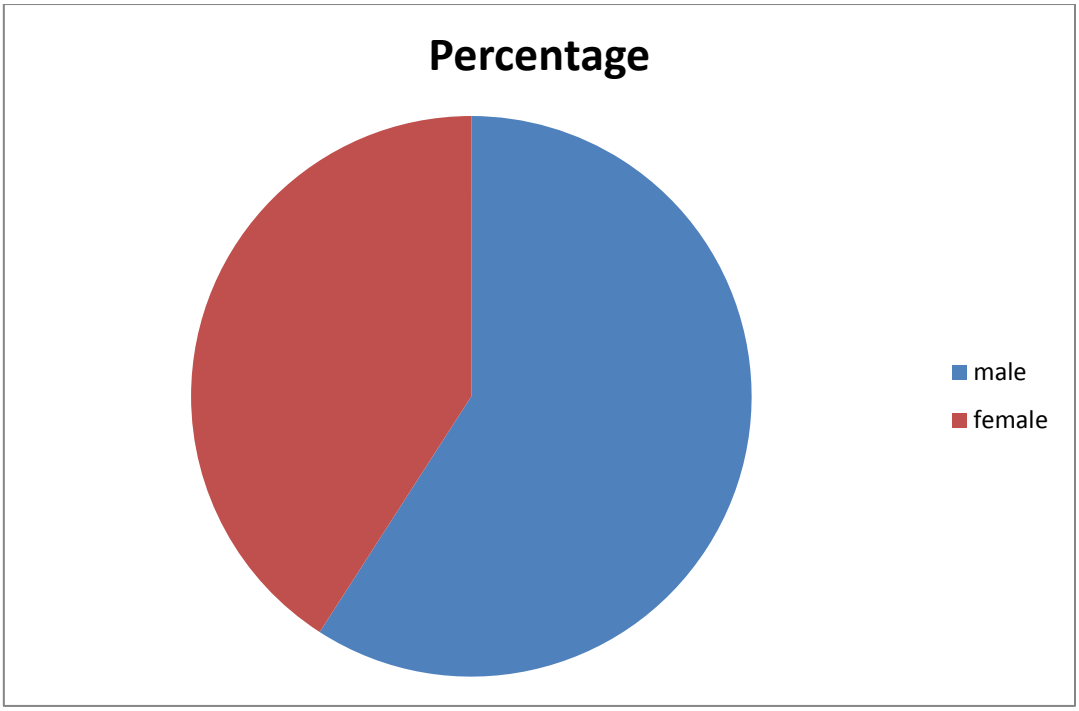
4.Csom in congenitally defective ears

RESULTS

Sex distribution

sex		
	Frequency	Percent
Male	67	40.9
Female	97	59.1
Total	164	100.0

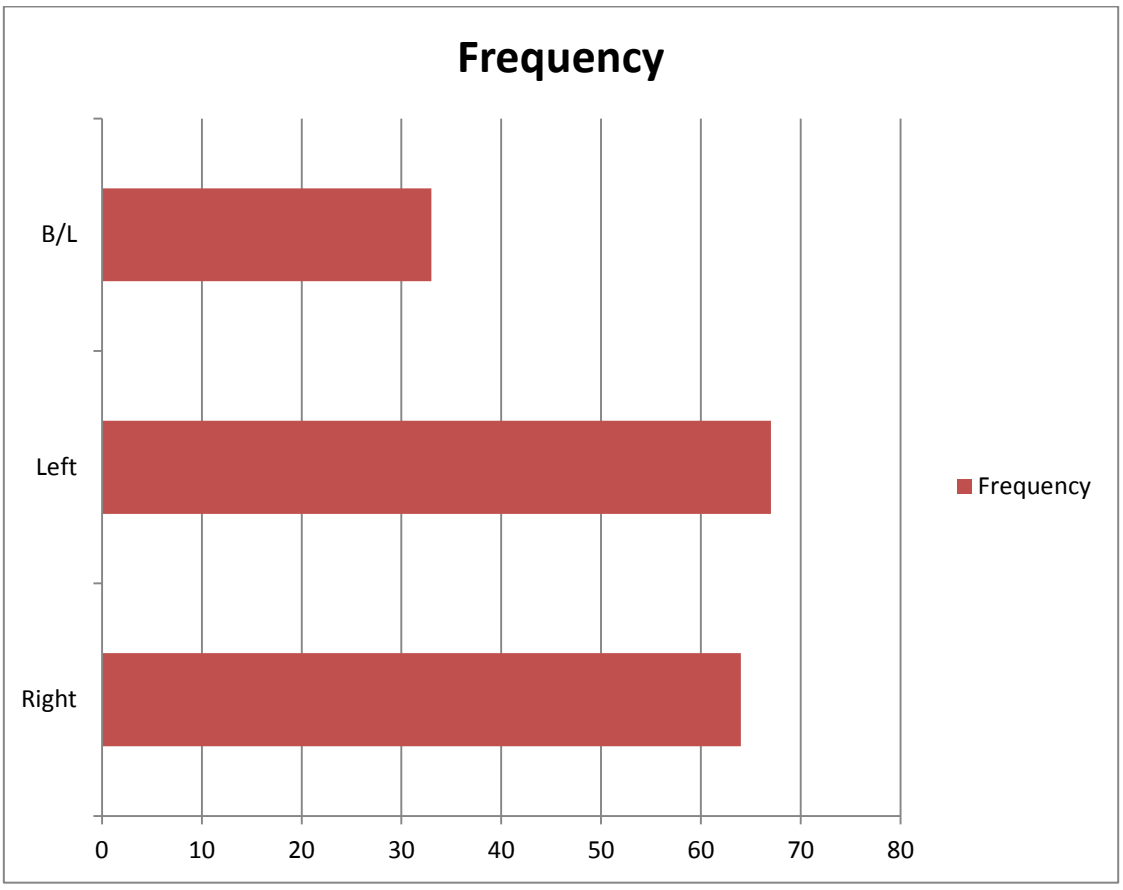




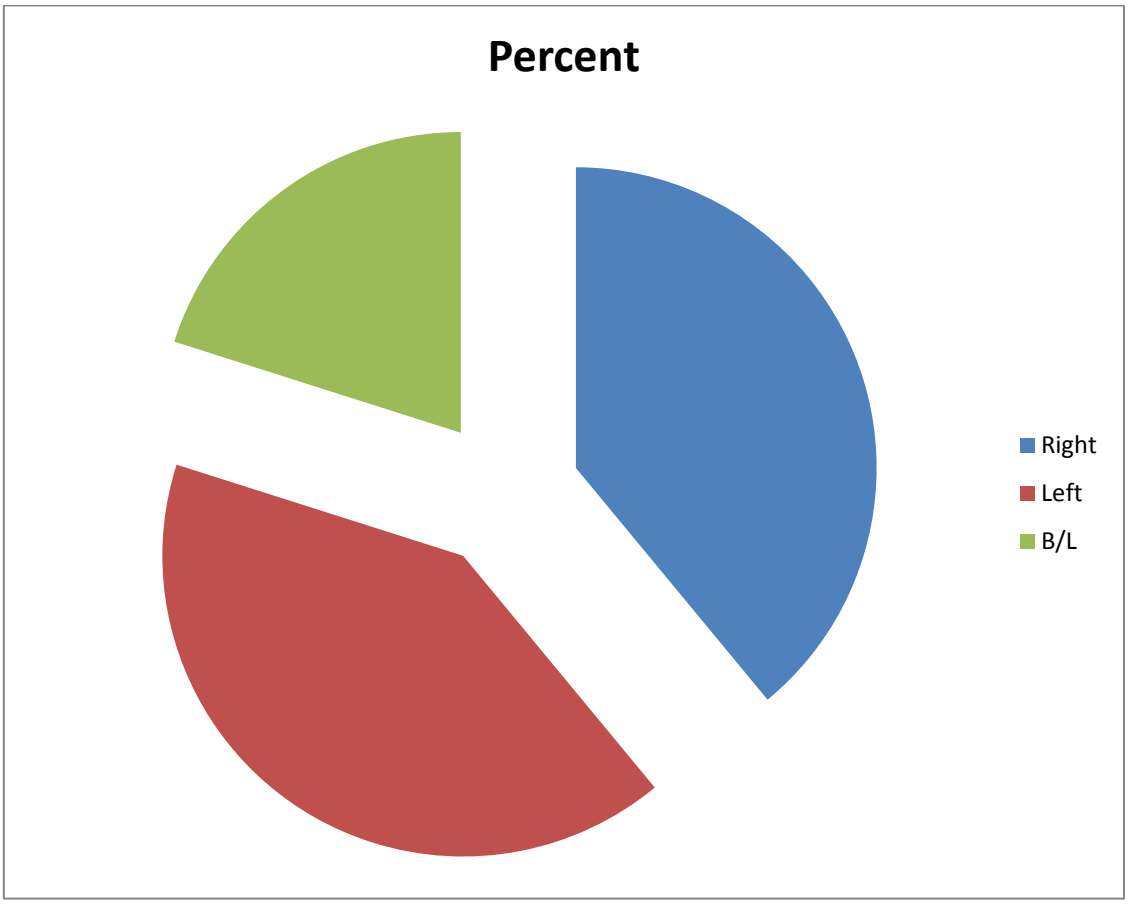
Of 164 patients, 40.9% were males and 59.1% were females

Side affected

Side affected		
	Frequency	Percent
Right	64	39.0
Left	67	40.9
B/L	33	20.1
Total	164	100.0

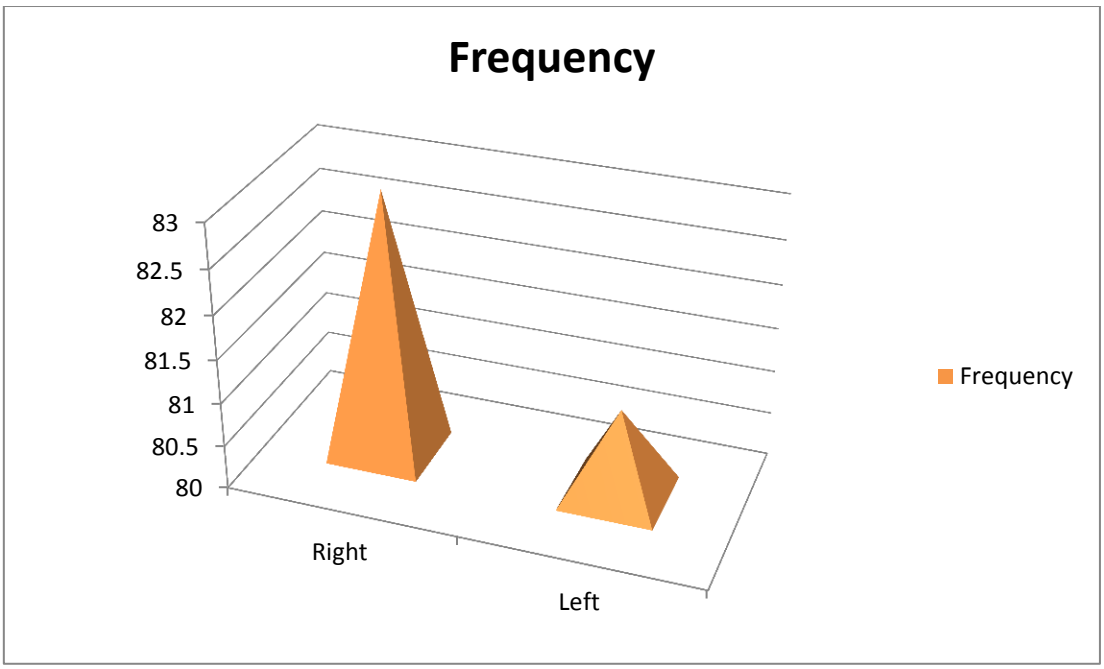


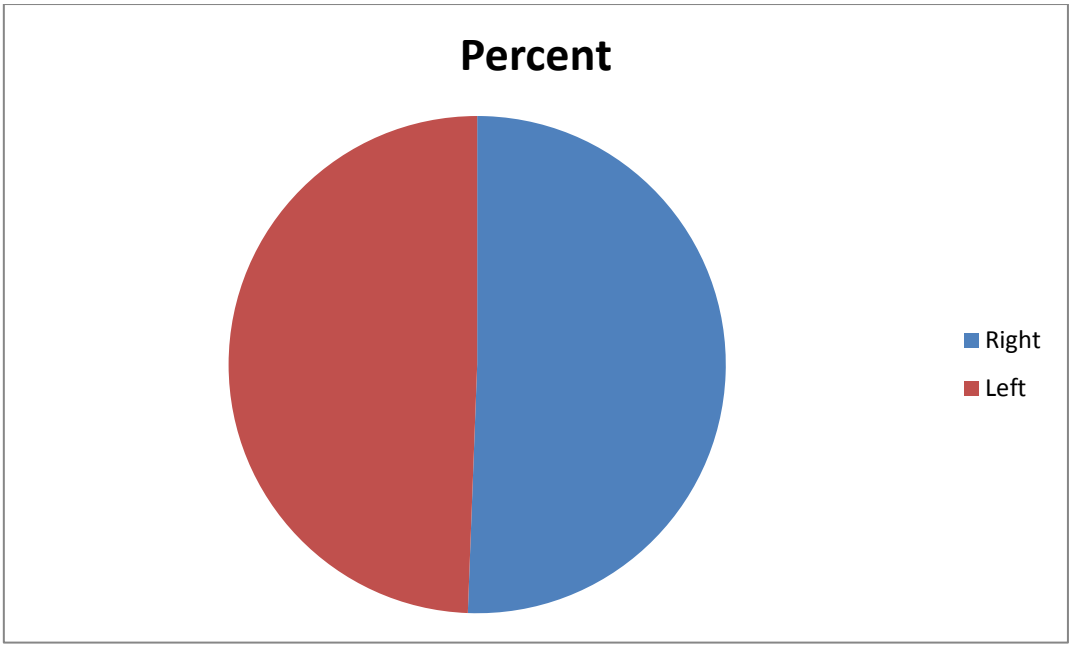
Of 164 patients that we prepared for mastoidectomy in my institute, 39% had right ear affected where as 40.9% had left ear affected. 20.1% presented with B/L CSOM



Ear of surgery

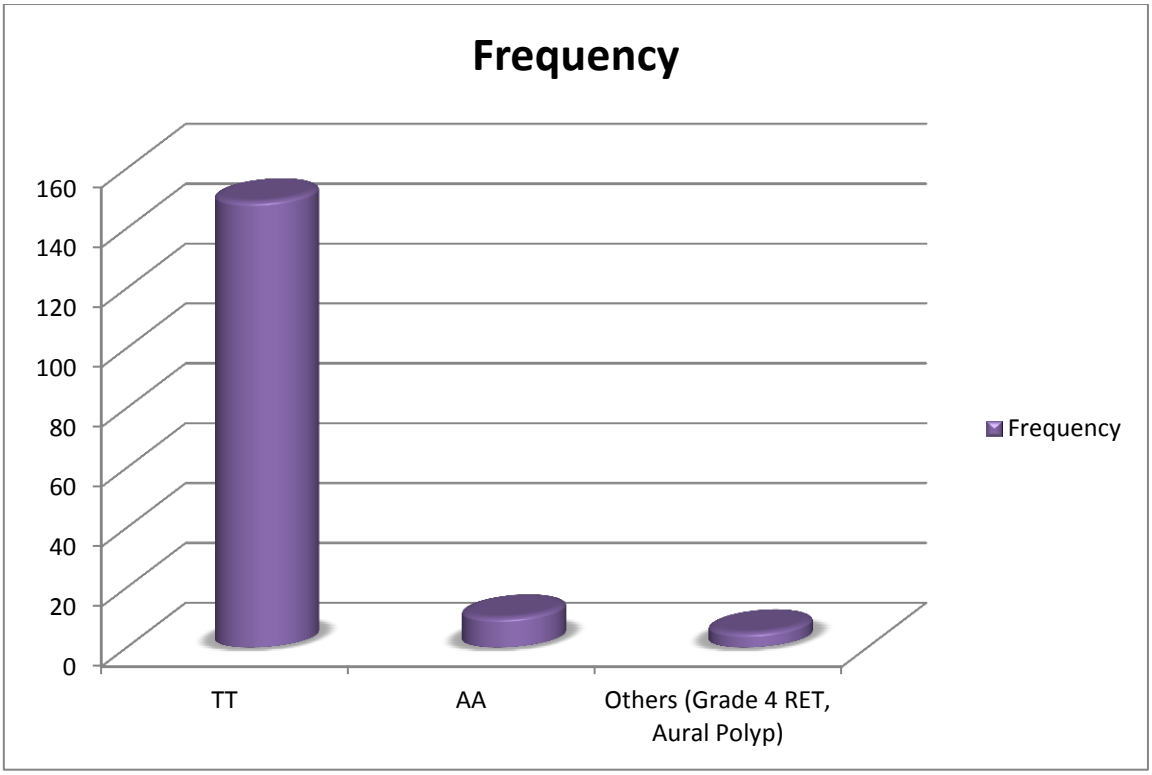
	Frequency	Percent
Right	83	50.6
Left	81	49.4
Total	164	100.0

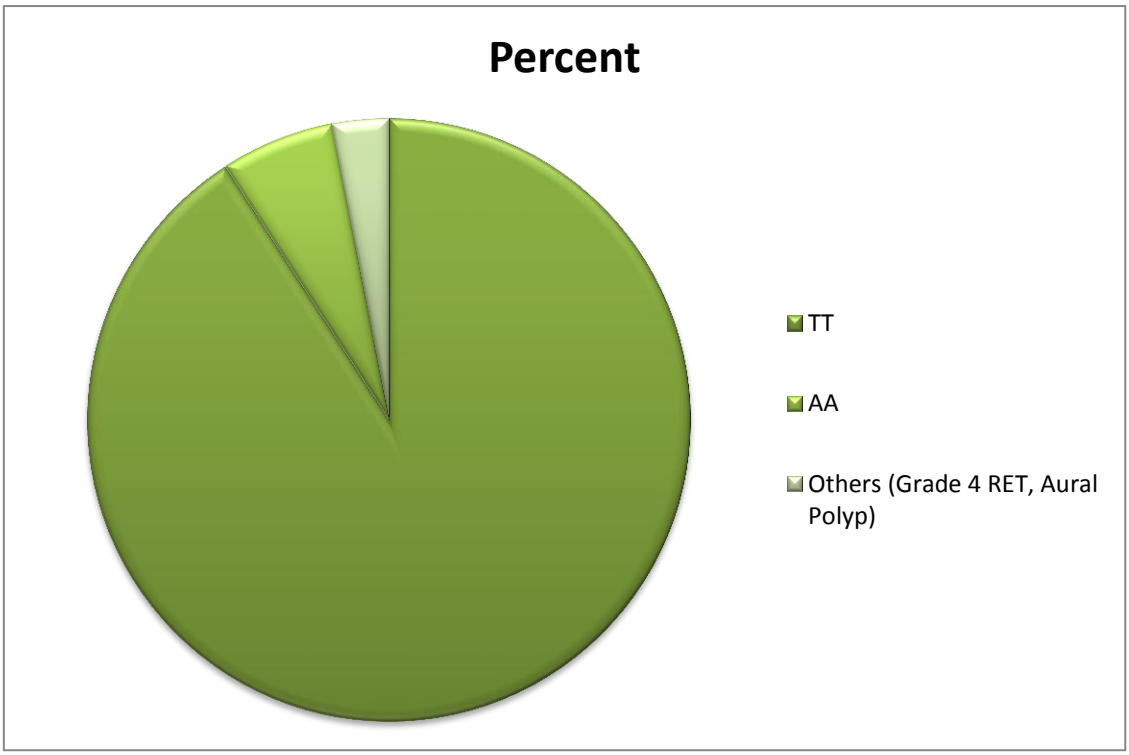




Classification of csom

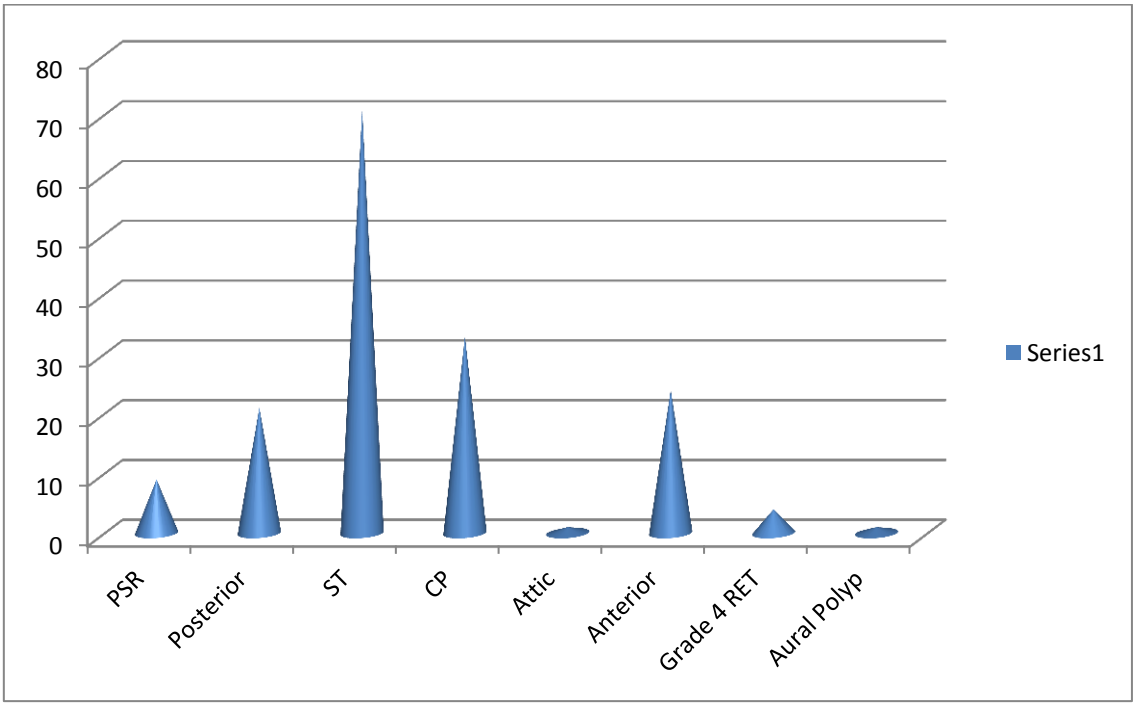
	Frequency	Percent
TT	149	90.85
AA	10	6.09
Others (Grade 4 RET, Aural Polyp)	5	3.04
Total	164	100.0


Frequency
160
140
120
100
80
60
40
20
0
TT
AA
Others (Grade 4 RET, Aural Polyp)
Frequency

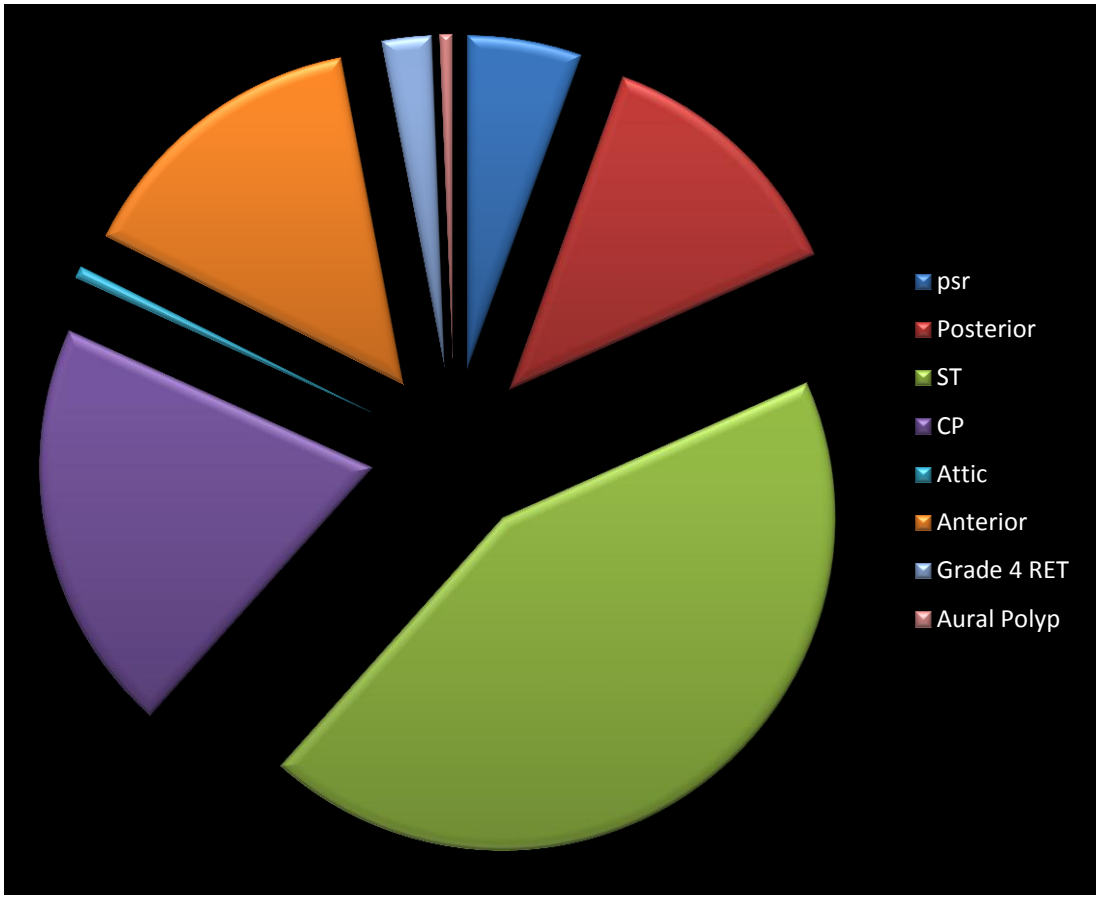

Percent
TT
AA
Others (Grade 4 RET, Aural Polyp)

In our institution, during my study period, out of 164 cases that was prepared for mastoidectomy, 90.85% cases were csom mucosal type and 6.09%. were csom Squamous type.

Pre-op otoscopic finding



	Frequency	Percent
PSR	9	5.5
Posterior	21	12.8
ST	71	43.2
CP	33	20.1
Attic	1	.6
Anterior	24	14.6
Grade 4 RET	4	2.4
Aural Polyp	1	.6
Total	164	100.0



PSR- Posterosuperior Retraction Pocket

Posterior –perforation more in posterior quadrant

ST – Subtotal Perforation

CP- small all quadrant central perforation

Attic – attic perforation

Anterior – Perforation more in anterior quadrant

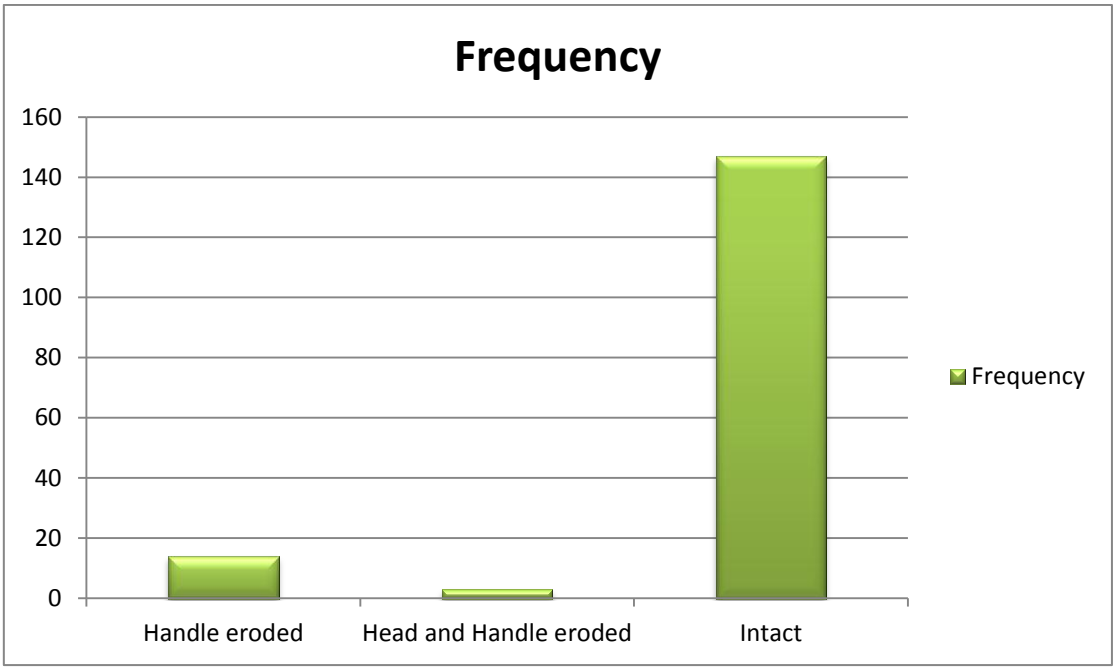
Grade 4 RET – Grade 4 Retraction(Adhesive otitis media)

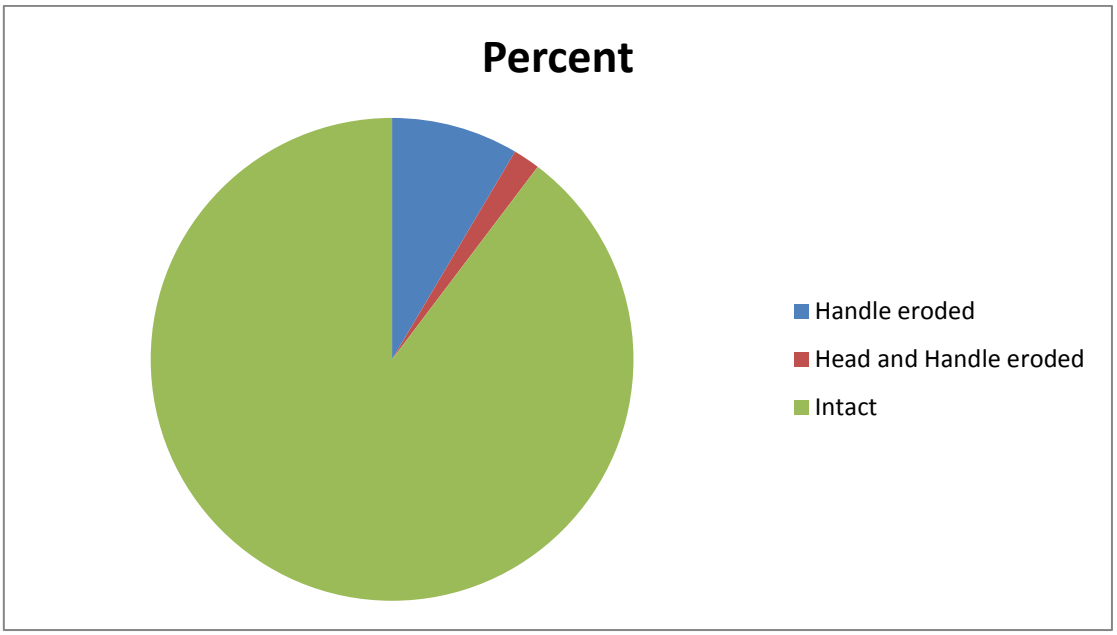
In my study, maximum number of tympanic membrane perforations that presented to us were subtotal perforations. Small all quadrant perforations were the next most common presentation

Status of ossicles

MALLEUS	Frequency	Percent
Handle eroded	14	8.5
Head and Handle eroded	3	1.8
Intact	147	89.6
Total	164	100.0
INCUS		
Long process eroded	40	24.4
Completely eroded	2	1.2
Intact	122	74.4
Total	164	100.0
STAPES		
Suprastructure eroded	13	7.9
Intact	151	92.1

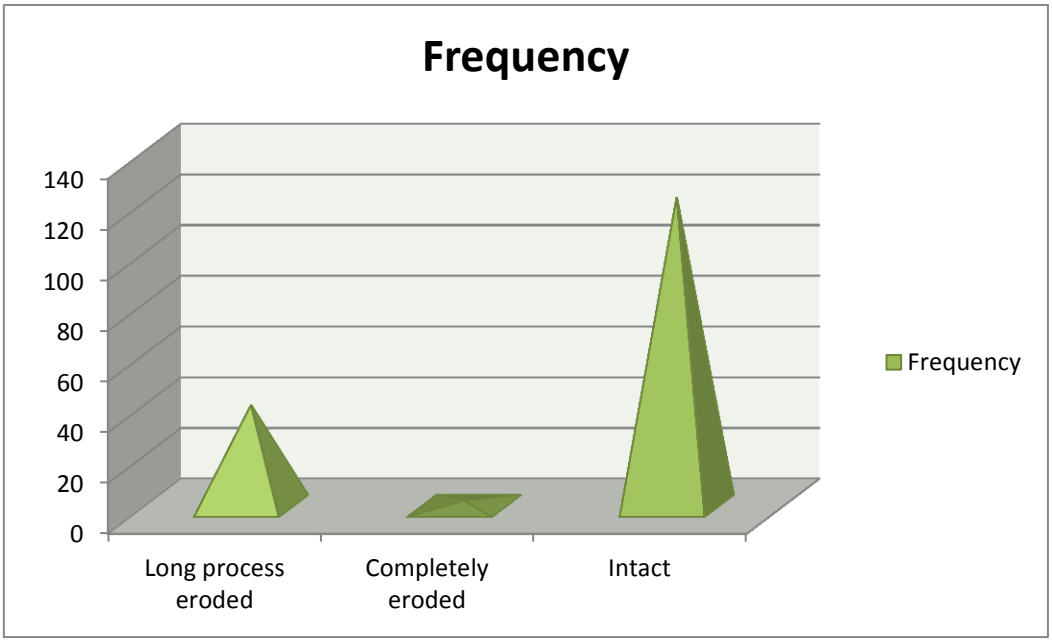
Malleus

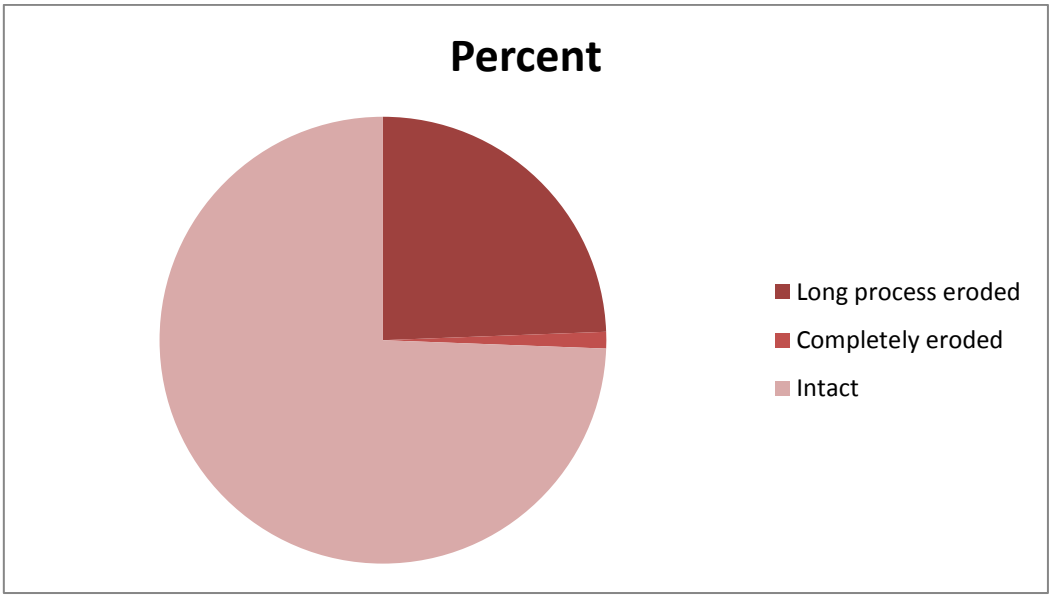




Malleus was intact in 147 cases out of 164 and thus proving as one among the most resistant ossicle

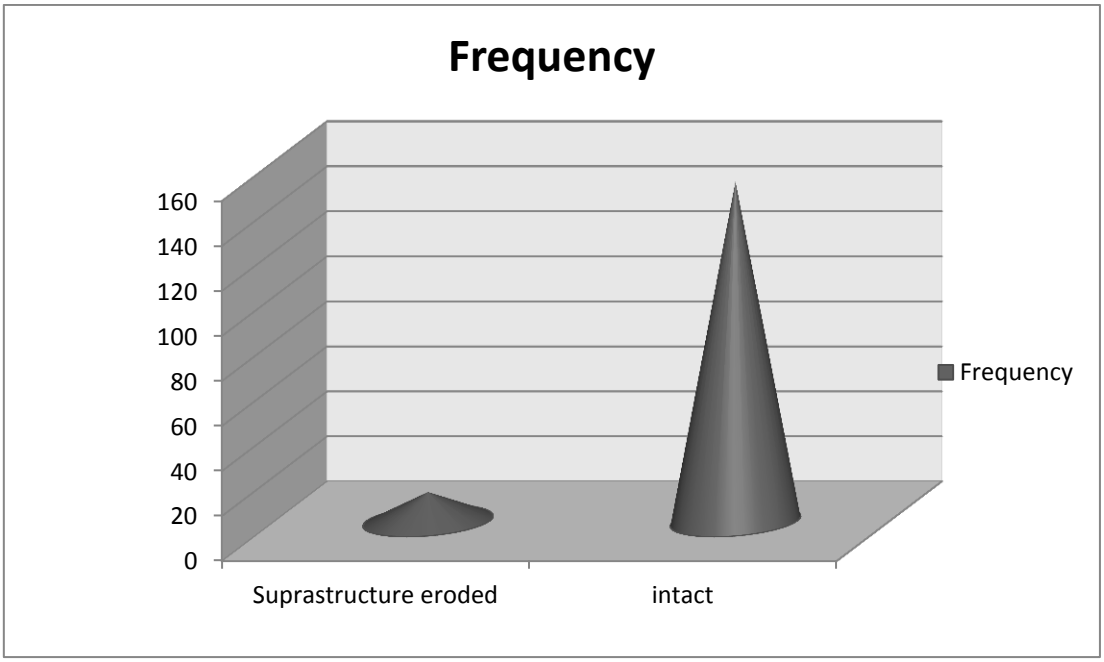
Incus

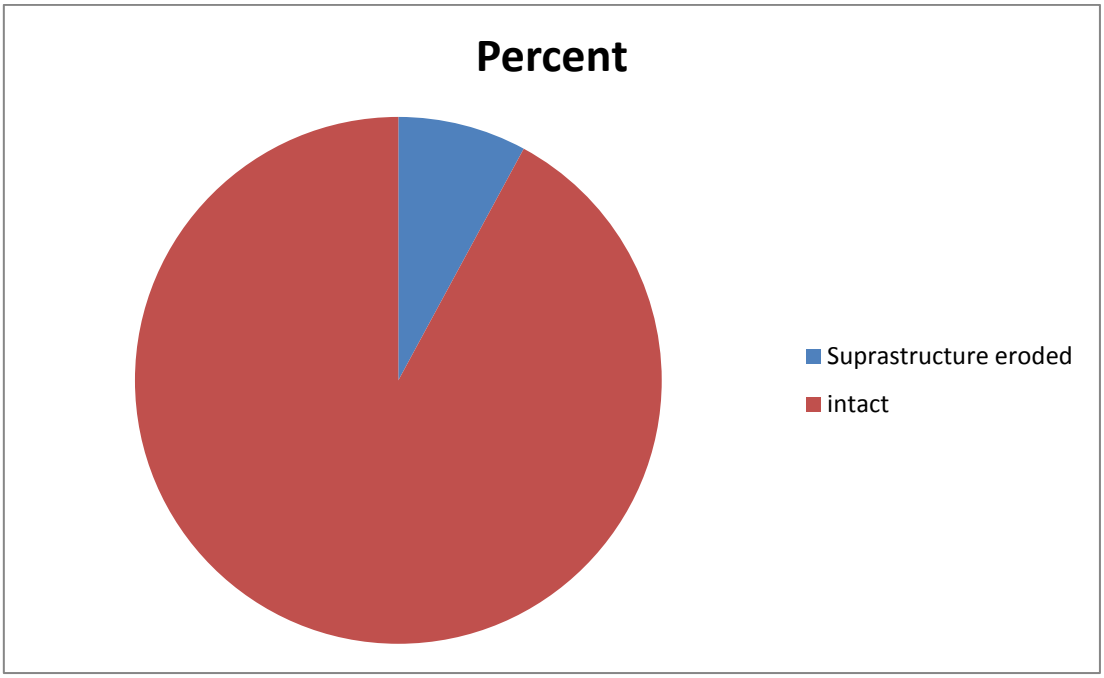




In 24.4% cases long process of incus was eroded , proving to be the most common ossicular erosion in csom cases

Stapes





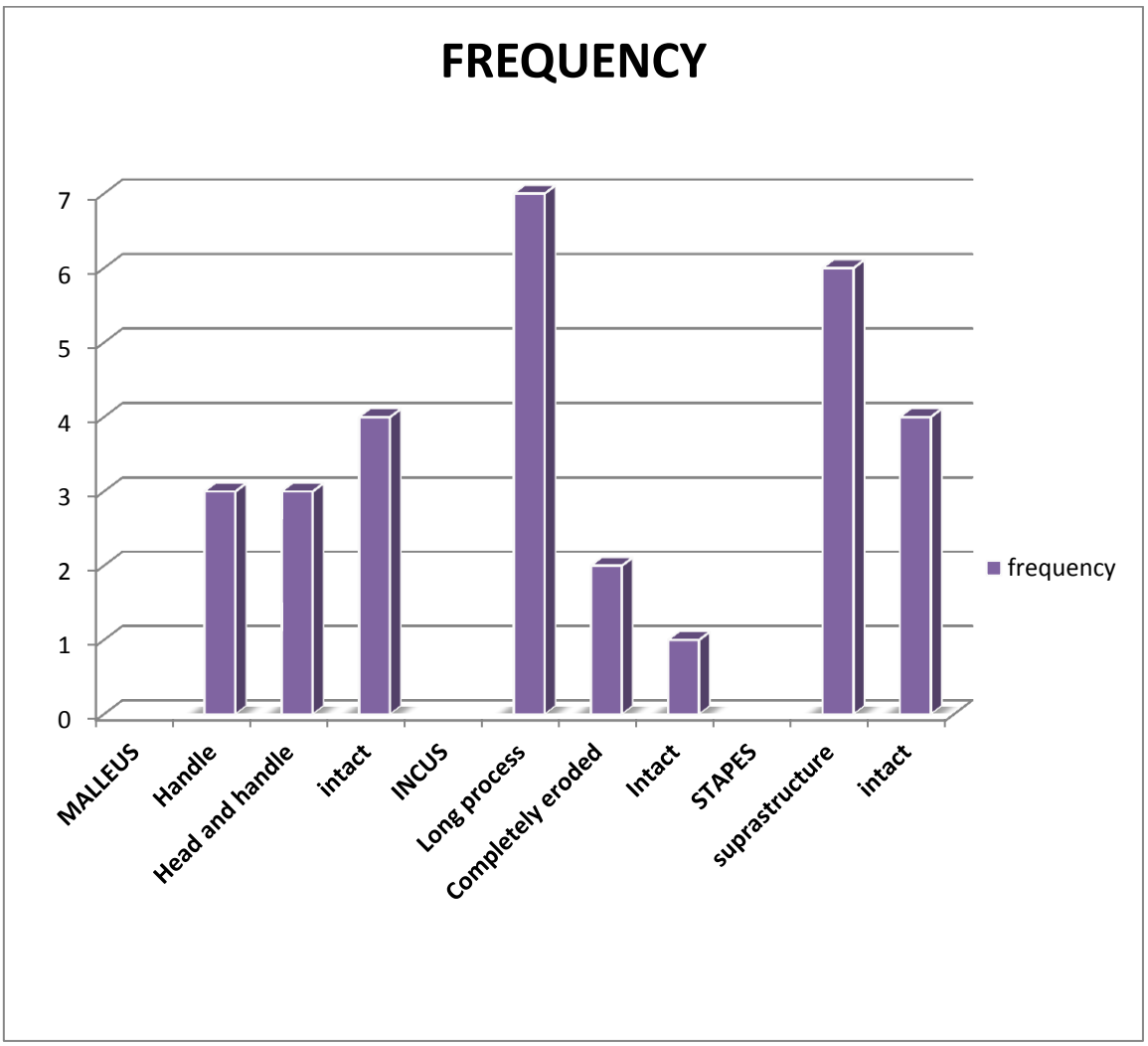
Only 7.9% cases had stapes erosion in our study. Thus stapes is also one among the resistant ossicles in the pathology of csom

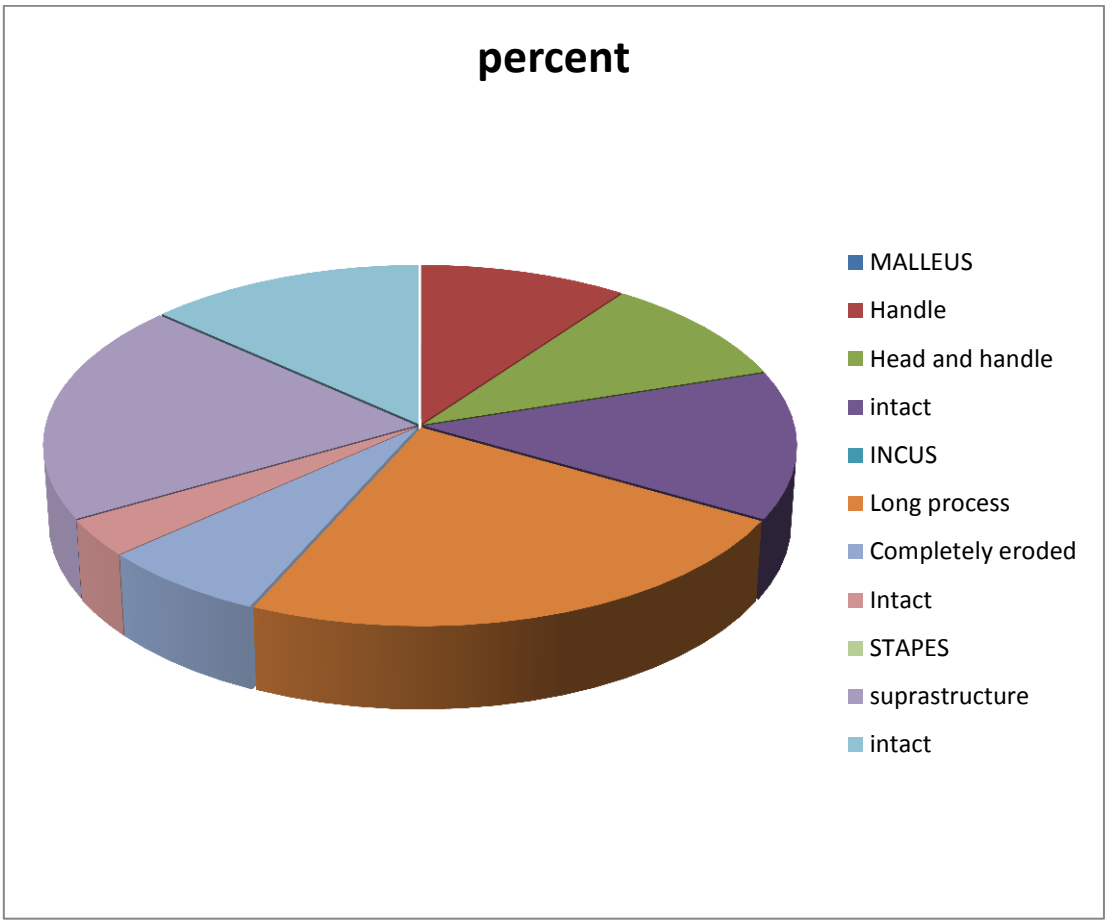
Classification of ossicular erosion based on tubotympanic and atticoantral type of csom

	Tubotympanic		Atticoantral		Others	
Malleus	F	P	F	P	F	P
Handle	8	5.36	3	30	2	40
Head and handle	0	0.00	3	30	0	0
intact	141	94.63	4	40	3	60
INCUS						
Long process	31	20.80	7	70	2	40
Completely eroded	0		2	20	0	
Intact	118	79.20	1	10	3	60
STAPES						
suprastructure	6	4.19	6	60	2	40
Intact	143	95.81	4	40	3	60

(F-Frequency, P-Percentage)

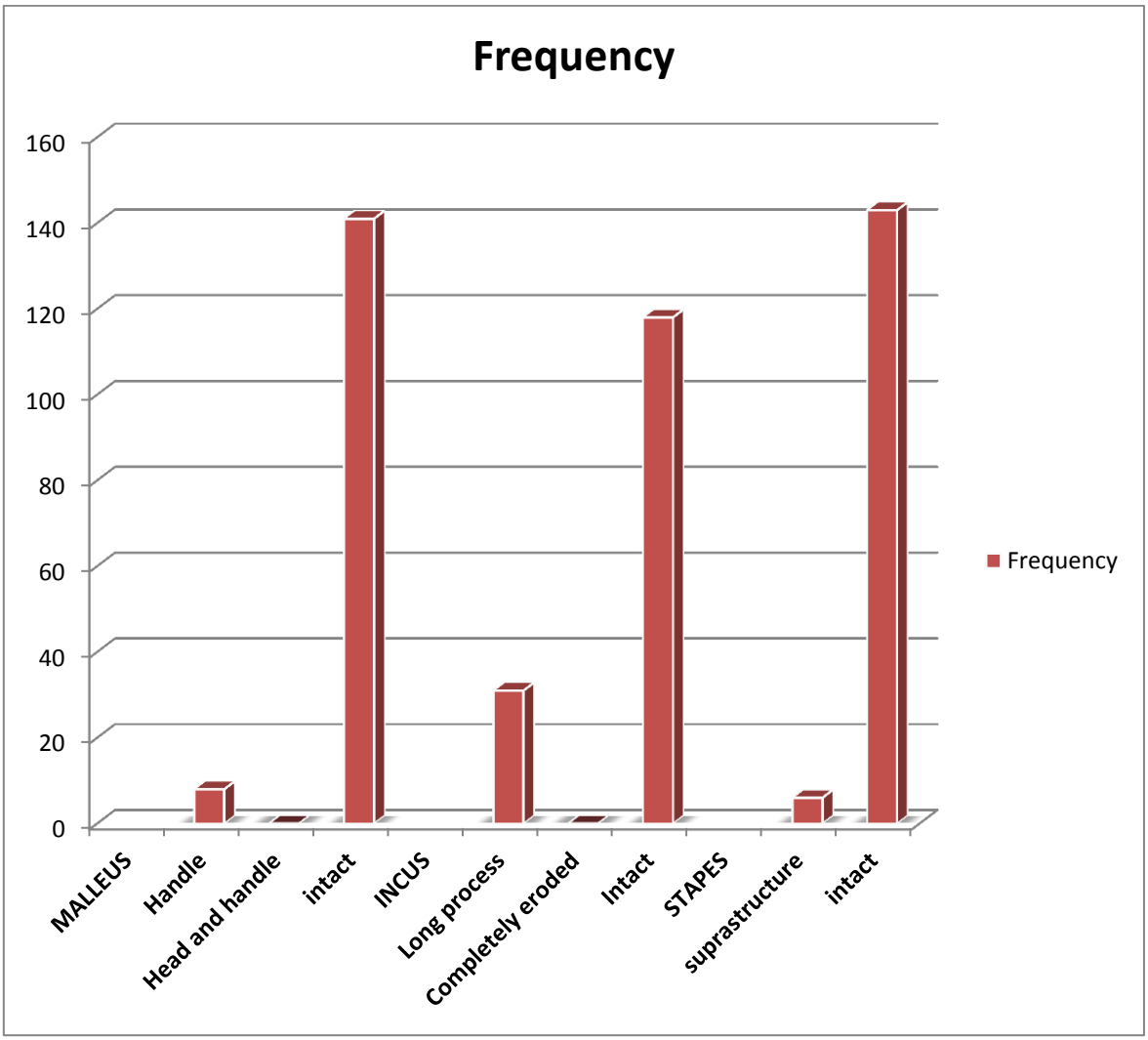
Atticoantral

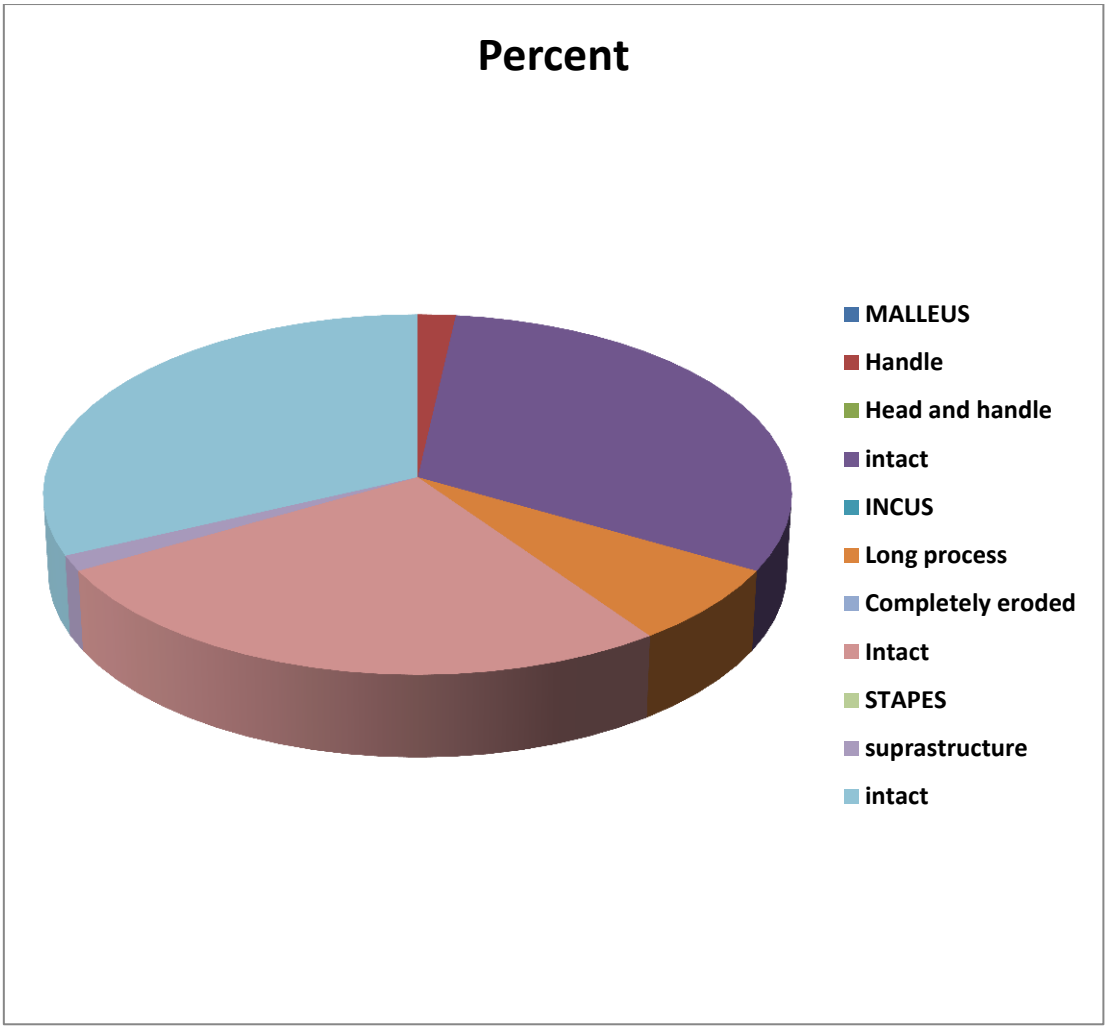




In atticoantral type of csom, long process of incus is the most common erosion found in my study. Percentage of erosion of each ossicle is higher in atticoantral than in tubotympanic.

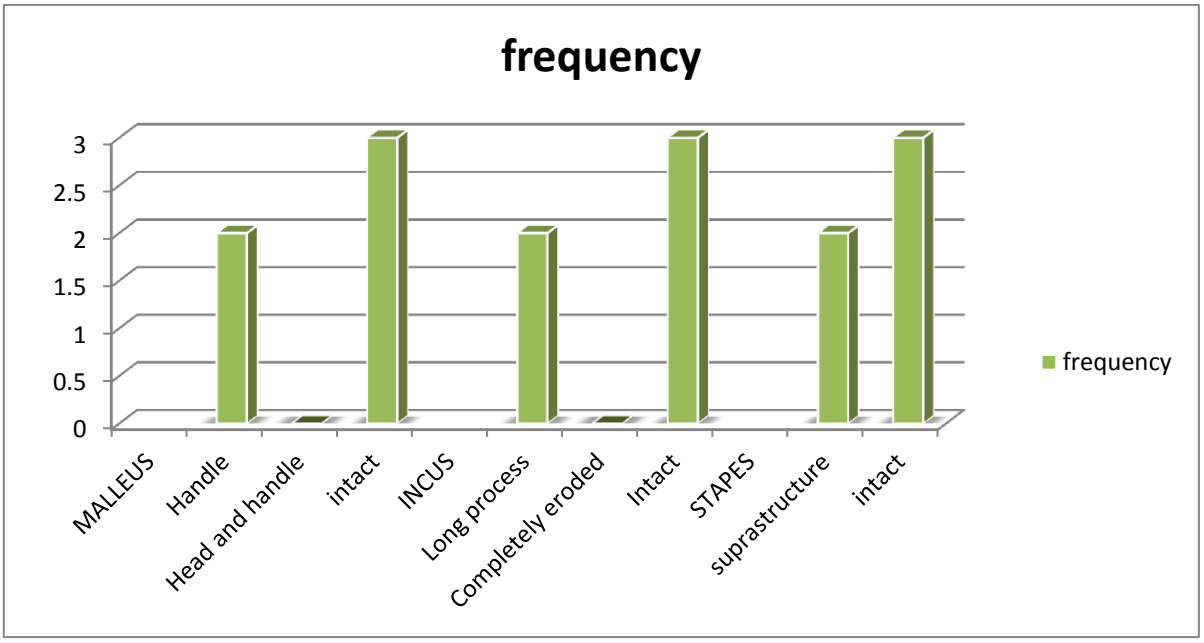
Tubotympanic

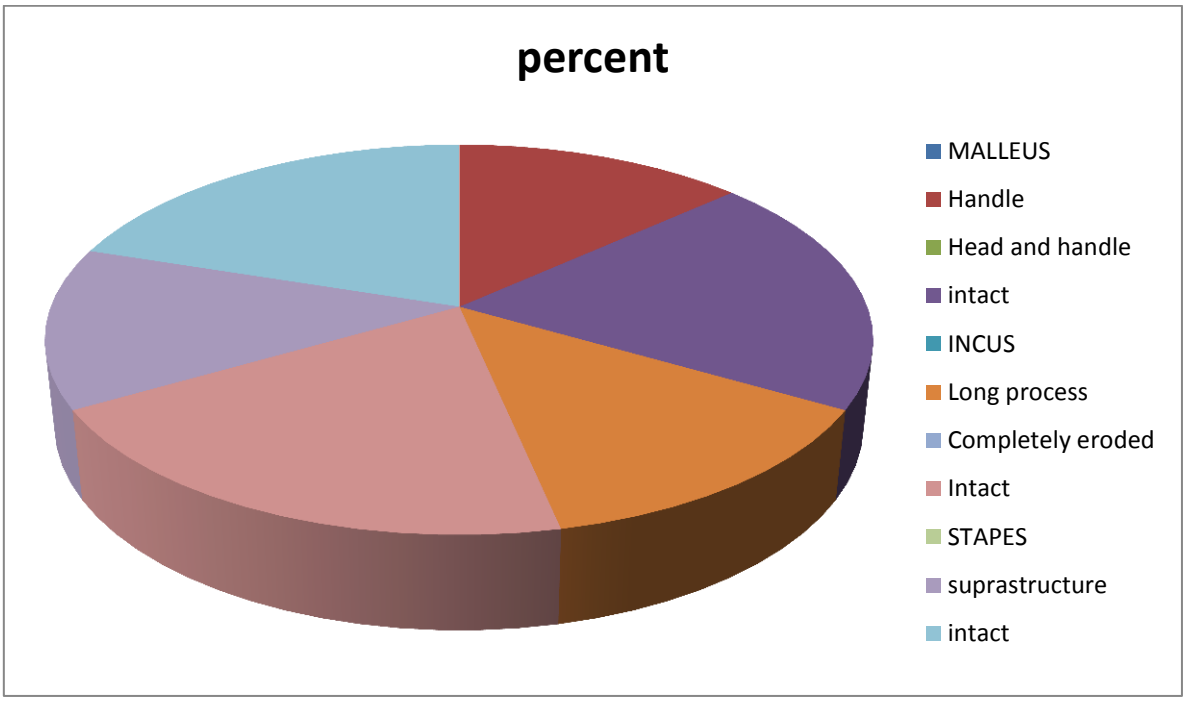




In csom mucosal type, ossicles were mostly intact, compared to squamous type. Among the eroded ossicles, long process of incus is most commonly eroded

Ossicular status in other conditions (adhesive otitis media)





Classification of surgeries done

	Frequency	Percent
CM, bone graft from post canal wall, over footplate arti with M	1	.6
CM, Bone graft from post canal wall, over footplate arti with neo TM	2	1.2
CM, I reshaped and kept bet M and SS	15	9.1
CM, I reshaped between SS and neo TM	1	.6
CM, M reshaped between footplate and neo TM, Conchal C over M	3	1.8
CM, M reshaped between SS and neo TM	2	1.2
CM, M reshaped between SS and neo TM, Conchal C over M	1	.6
CM, TYPE 1 Tym	114	69.5
CM, TYPE 1 Tym, Conchal C under the handle	2	1.2
CM, TYPE 2 Tym	1	.6

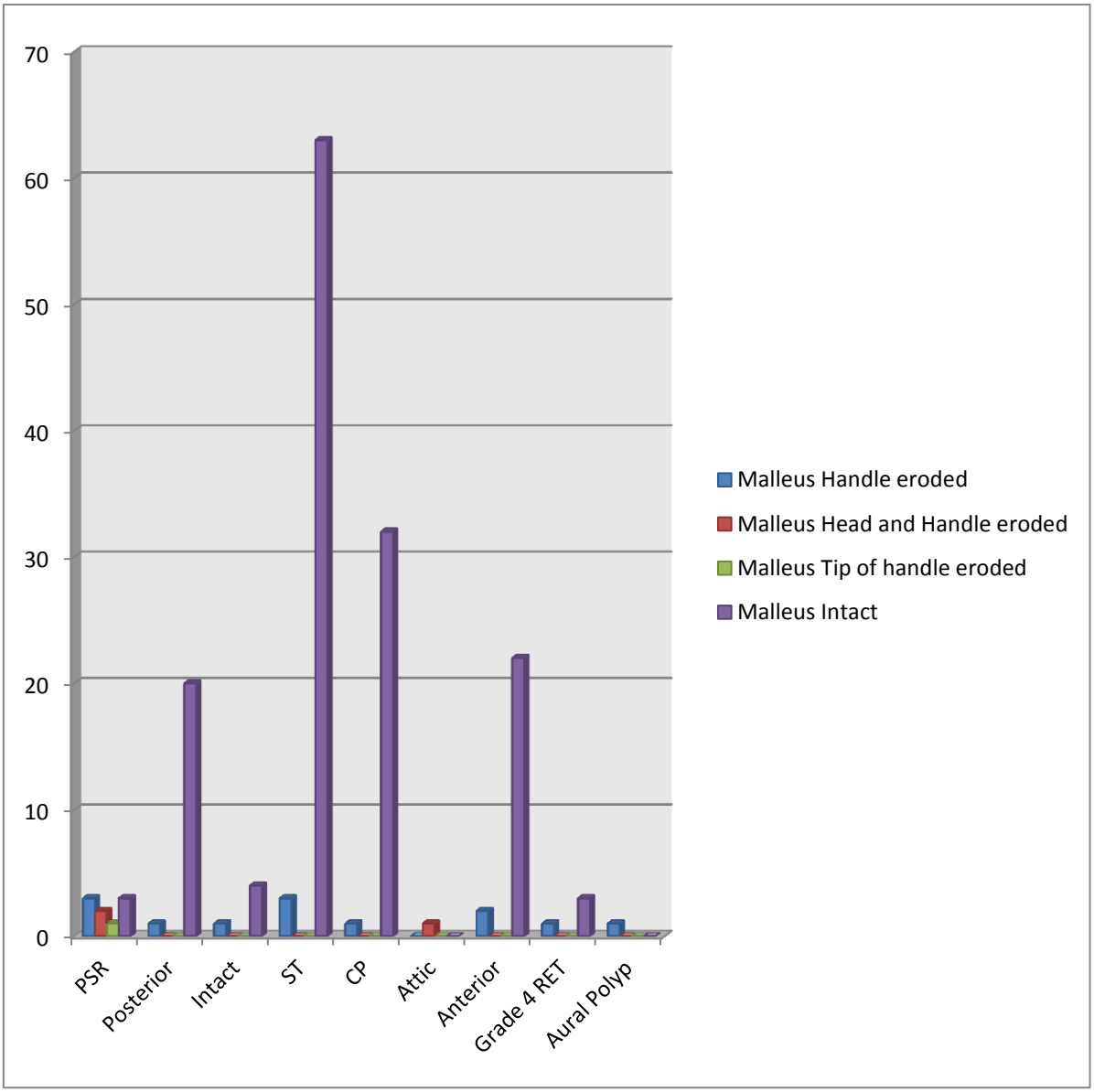
CM, TYPE 3 Tym	5	3.0
CM, TYPE 3 Tym, Conchal cover SS	2	1.2
CM,M reshaped and placed over SS	3	1.8
MRM, bone graft from post canal wall, over footplate	2	1.2
MRM, M reshaped between footplate and neo TM	1	.6
MRM, TYPE 1 Tym, Conchal C Under the handle	1	.6
MRM, TYPE 3 Tym	3	1.8
MRM, TYPE 4 Tym	4	2.4
MRM,M reshaped and kept over footplate	1	.6
Total	164	100.0

In my study, maximum cases were managed by Cortical mastoidectomy with type 1 tympanoplasty. In few cases, when the remaining ossicles were unhealthy for ossicular reconstruction , we tried harvesting a bone graft from posterior canal wall and drilling and grafting was done in such bone grafts and ossiculoplasty was done . Such cases are also included in my study. 15 cases were managed by transposition of incus between malleus and suprastructure of stapes. Conchal cartilage was grafted in few cases to in ossiculoplasty and in all these cases, the cartilage graft was placed medial to temporalis fascis graft to prevent retraction of the graft.

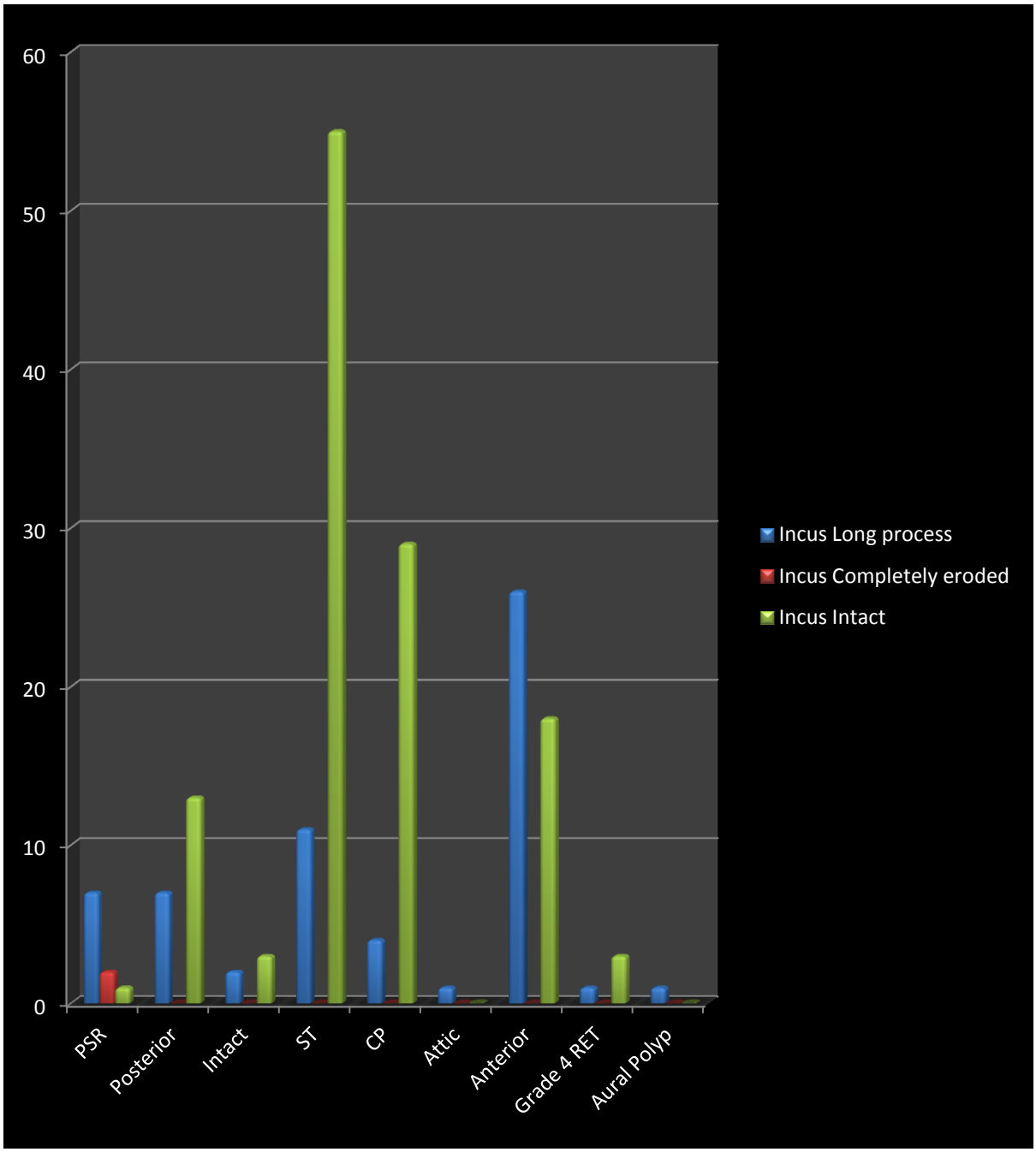
Ossicular status Vs tympanic membrane perforation

	Malleus				Incus			stapes	
	Handle eroded	Head and Handle eroded	Tip of handle eroded	Intact	Long process	Completely eroded	Intact	suprastructure	Intact
PSR	3	2	1	3	7	2	1	5	3
Posterior	1	0	0	20	7	0	13	1	20
Intact	1	0	0	4	2	0	3	0	5
ST	3	0	0	63	11	0	55	1	65
CP	1	0	0	32	4	0	29	1	32
Attic	0	1	0	0	1	0	0	0	1
Anterior	2	0	0	22	26	0	18	3	21
Grade 4 RET	1	0	0	3	1	0	3	1	3
Aural Polyp	1	0	0	0	1	0	0	1	0

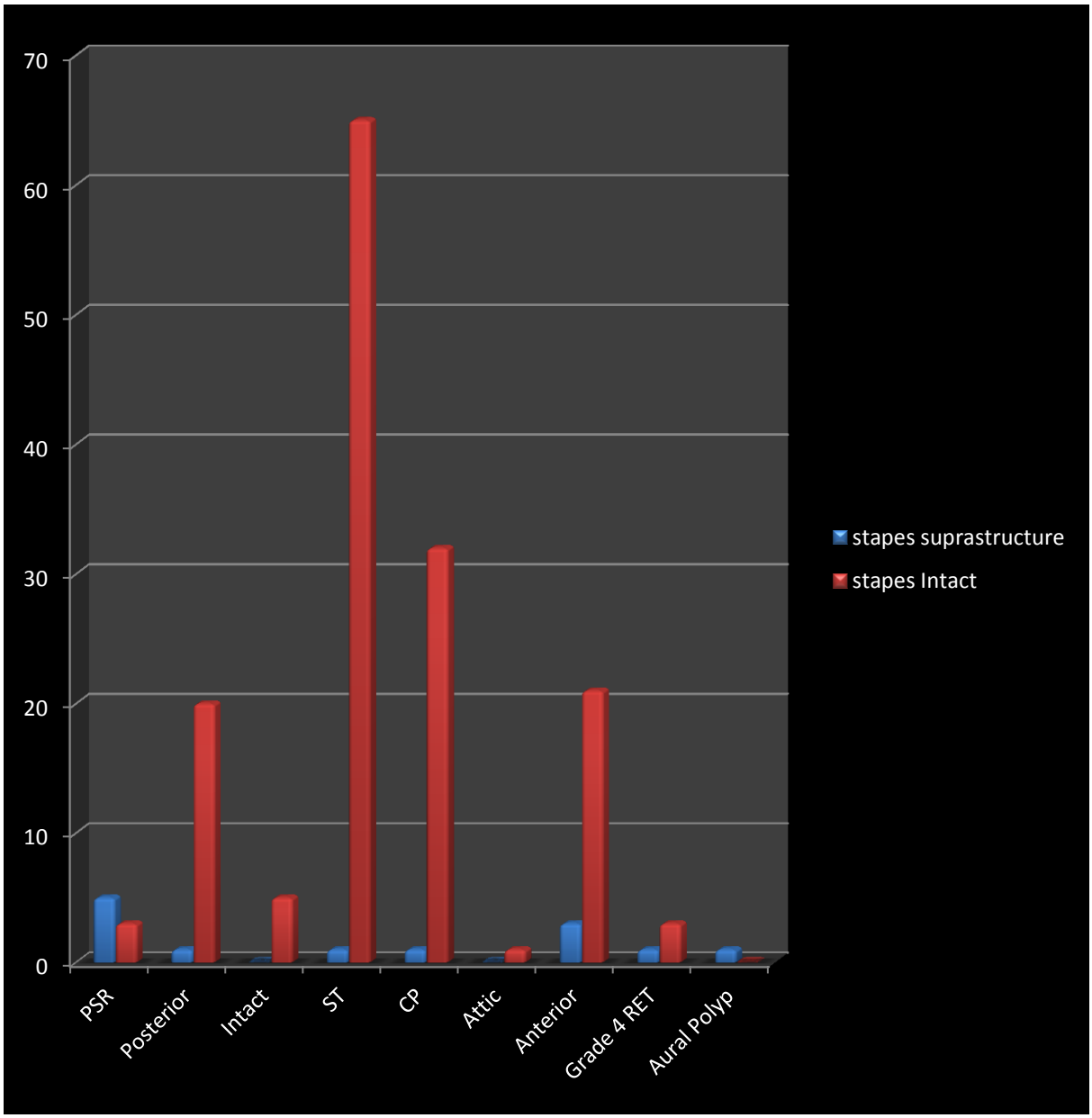
Malleus


70
60
50
40
30
20
10
0
PSR
Posterior
Intact
ST
CP
Attic
Anterior
Grade 4 RET
Aural Polyp
Malleus Handle eroded
Malleus Head and Handle eroded
Malleus Tip of handle eroded
Malleus Intact

Incus


60
50
40
30
20
10
0
PSR
Posterior
Intact
ST
CP
Attic
Anterior
Grade 4 RET
Aural Polyp
Incus Long process
Incus Completely eroded
Incus Intact

Stapes

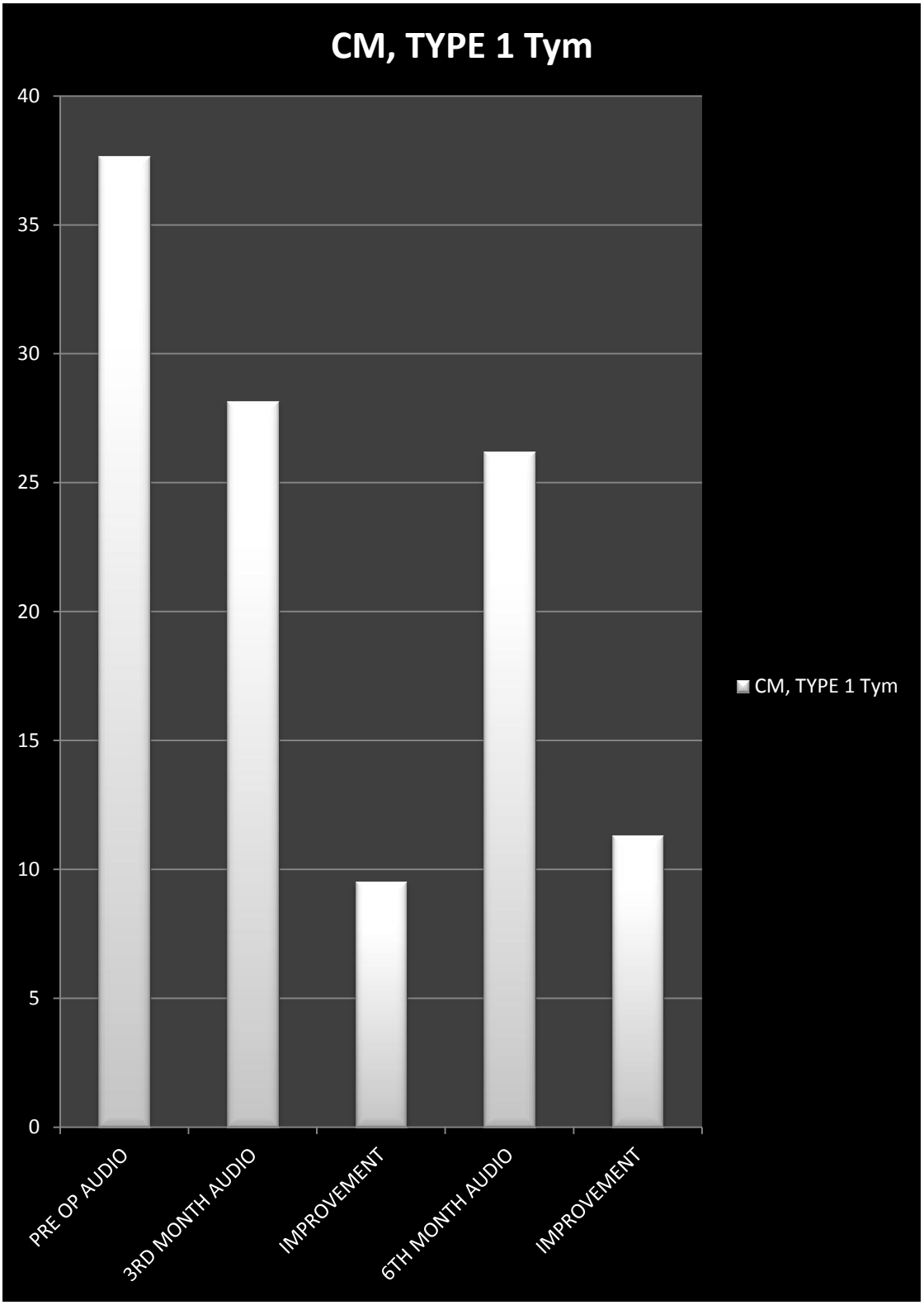

70
60
50
40
30
20
10
0
PSR
Posterior
Intact
ST
CP
Attic
Anterior
Grade 4 RET
Aural Polyp
stapes suprastructure
stapes Intact

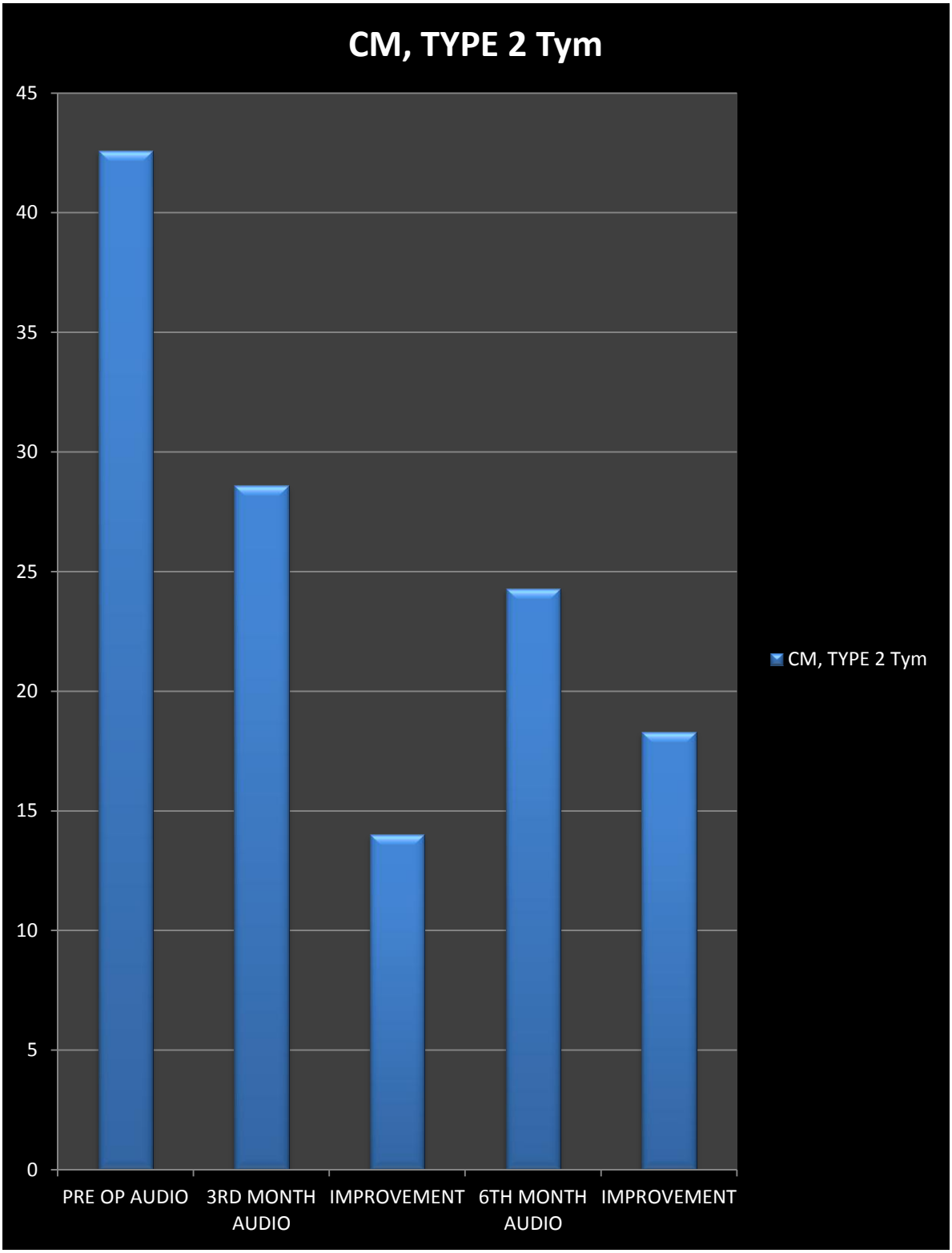
Assessment of audiological improvement

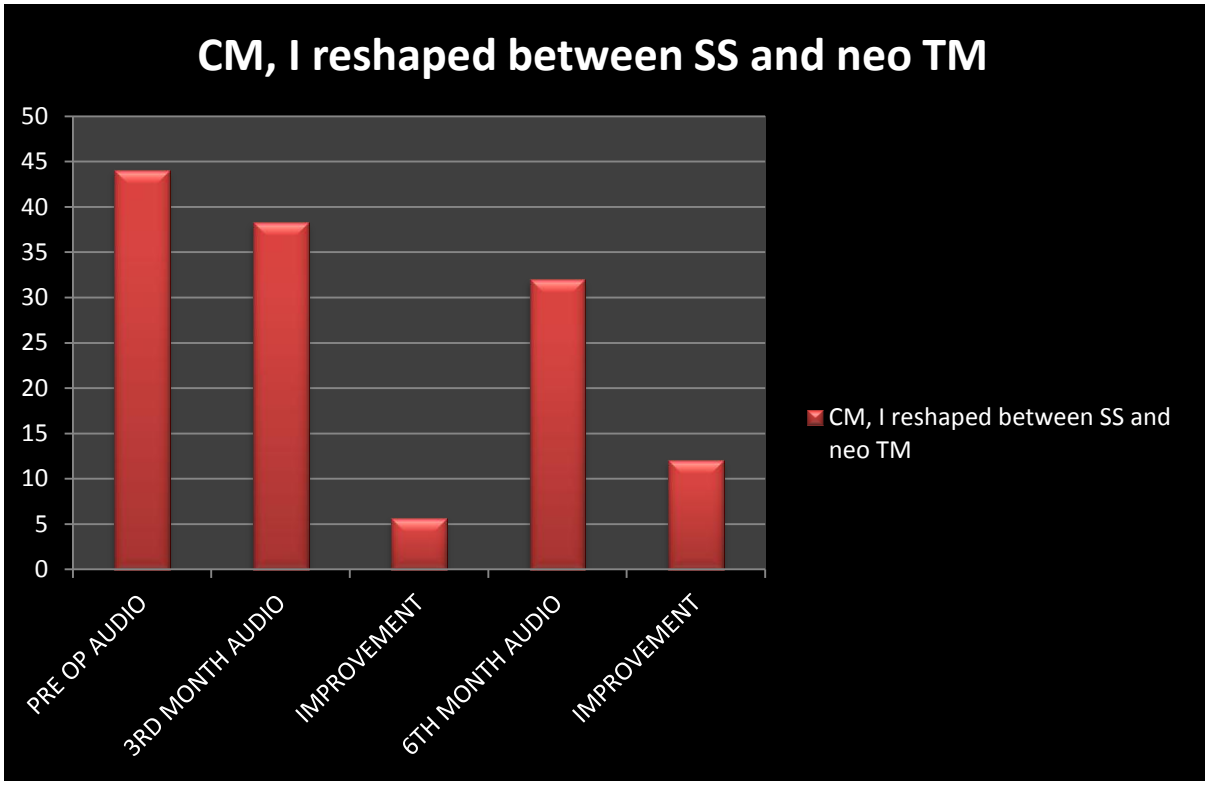
Type of surgery		Pre-op PTA	3rd month PTA	Improvement	6th month PTA	Improvement
CM, TYPE 1 Tym	Preop PTA in Ear of Surgery	37.67	28.16	9.50	26.21	11.30
CM, TYPE 1 Tym, Conchal C under the handle	Preop PTA in Ear of Surgery	30.65	36	-5.35	38.95	-8.30
CM, TYPE 2 Tym	Preop PTA in Ear of Surgery	42.60	28.60	14	24.30	18.3
CM, TYPE 3 Tym	Preop PTA in Ear of Surgery	34.98	27.56	7.42	27.98	7.00
CM, TYPE 3 Tym, Conchal cover SS	Preop PTA in Ear of Surgery	30.45	25.00	5.45	25.30	5.15
CM, bone graft from post canal wall, over footplate	Preop PTA in Ear of Surgery	26.40	26	0.40	26.30	0.10

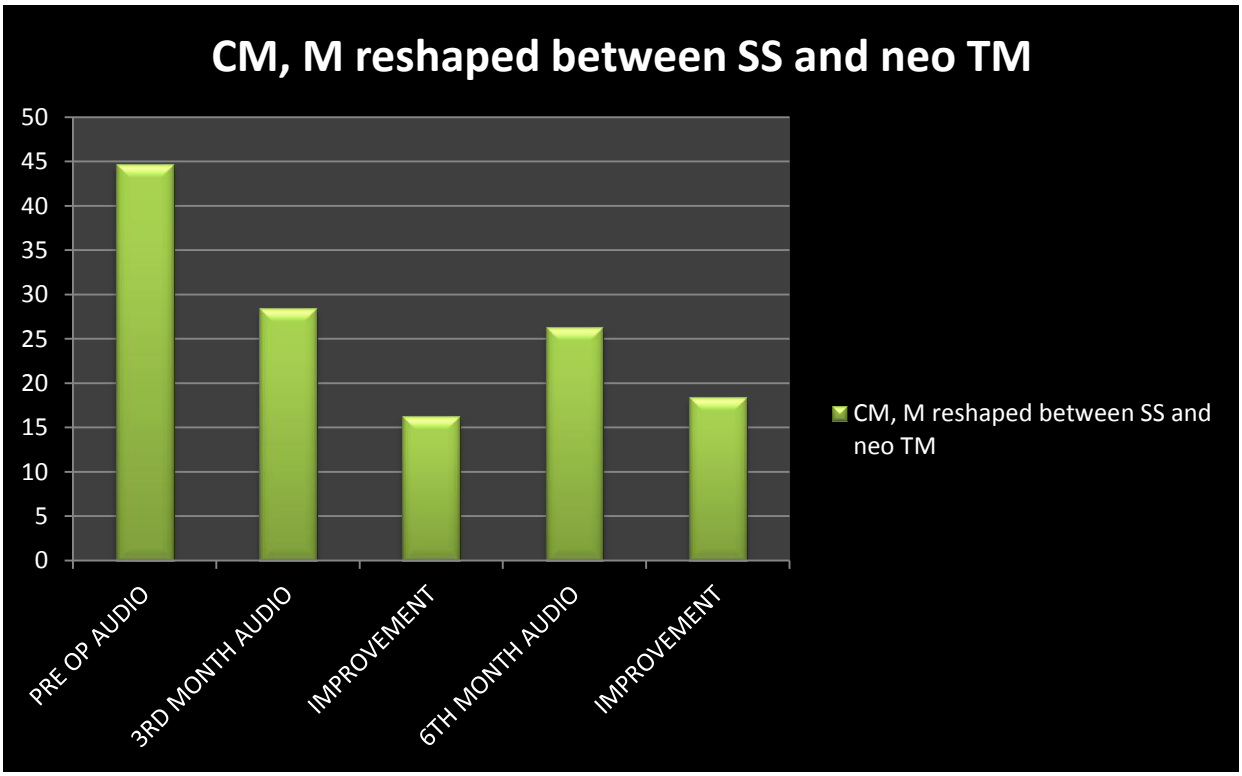
arti with M						
CM, Bone graft from post canal wall, over footplate arti with neo TM	Preop PTA in Ear of Surgery	40.05	32.30	7.75	31.15	8.90
CM, I reshaped and kept bet M and SS	Preop PTA in Ear of Surgery	40.64	32.45	8.19	29.61	9.70
CM, I reshaped between SS and neo TM	Preop PTA in Ear of Surgery	44.00	38.30	5.70	32.00	12.00
CM, M reshaped between footplate and neo TM, Conchal C over M	Preop PTA in Ear of Surgery	33.73	31.53	2.20	29.66	4.06
CM, M reshaped between SS and neo TM	Preop PTA in Ear of Surgery	44.65	28.45	16.30	26.30	18.35
MRM, bone graft	Preop PTA in Ear of	33.60	30.50	3.10	29.00	4.60

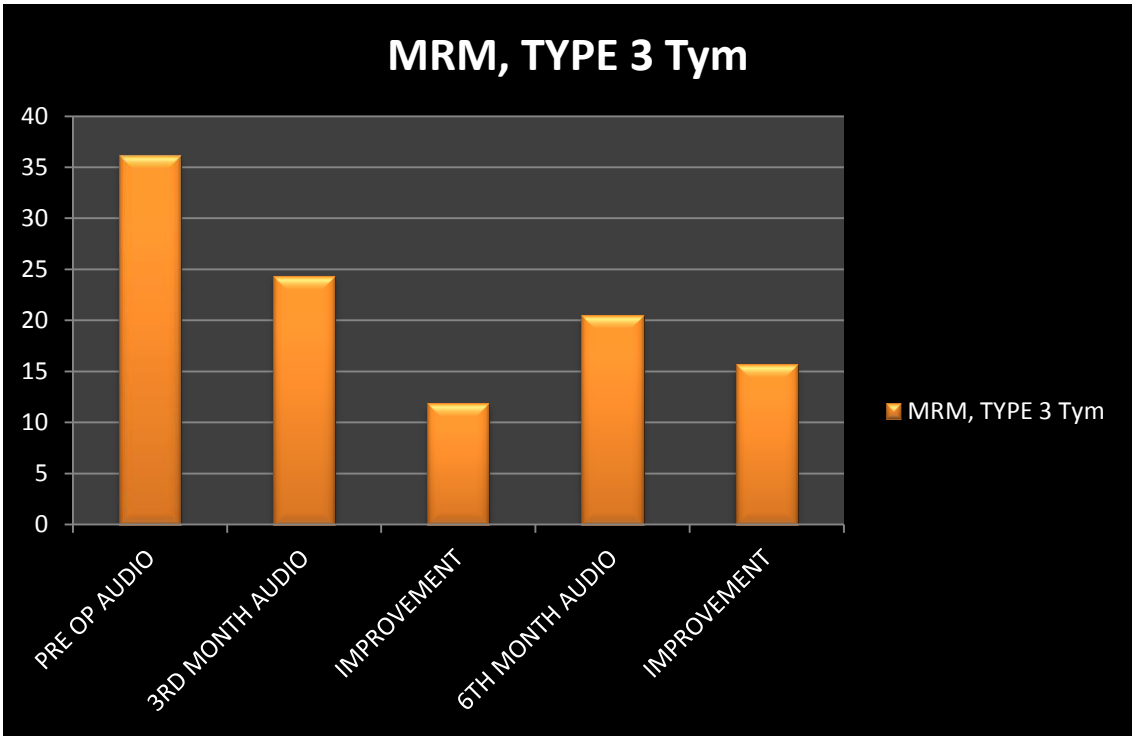
from post canal wall, over footplate	Surgery					
MRM, M reshaped between footplate and neo TM	Preop PTA in Ear of Surgery	31.30	30.30	1.00	26.00	5.30
MRM, TYPE 1 Tym, Conchal C Under the handle	Preop PTA in Ear of Surgery	40.00	34.00	6.00	31.20	8.80
MRM, TYPE 3 Tym	Preop PTA in Ear of Surgery	36.20	24.33	11.86	20.53	15.66
MRM, TYPE 4 Tym	Preop PTA in Ear of Surgery	38.40	29.25	9.15	25.30	13.10
MRM,M reshaped and kept over footplate	Preop PTA in Ear of Surgery	40.00	36.00	4.00	32.00	8.00

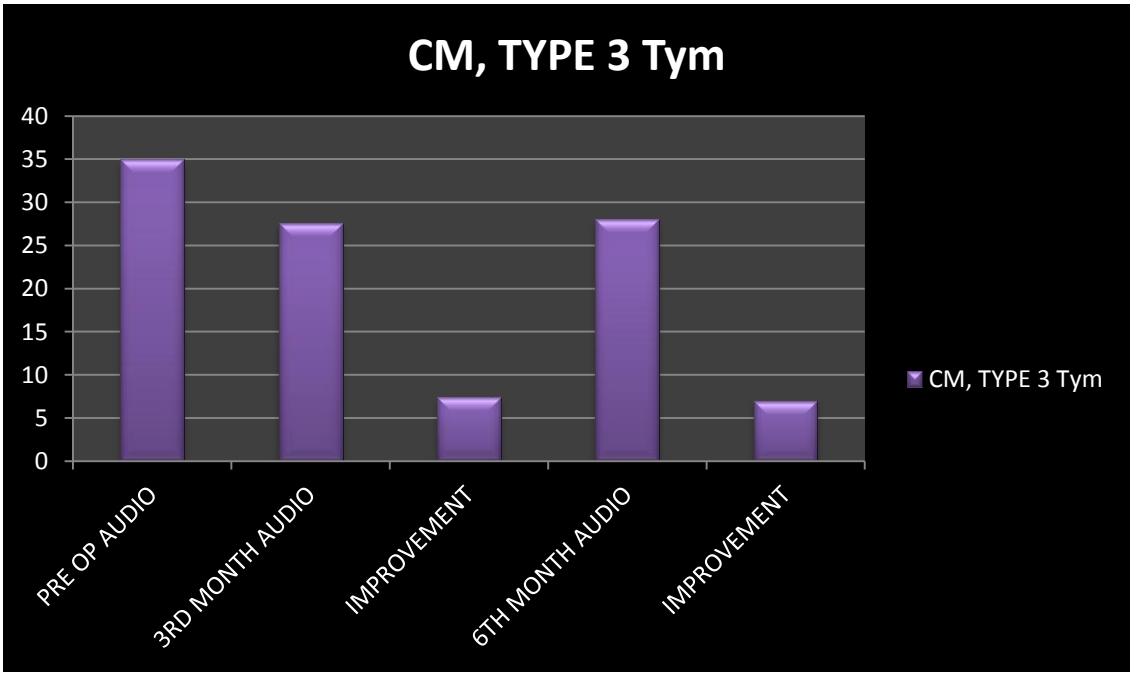

CM, TYPE 1 Tym
40
35
30
25
20
15
10
5
0
PRE OP AUDIO
3RD MONTH AUDIO
IMPROVEMENT
6TH MONTH AUDIO
IMPROVEMENT
CM, TYPE 1 Tym

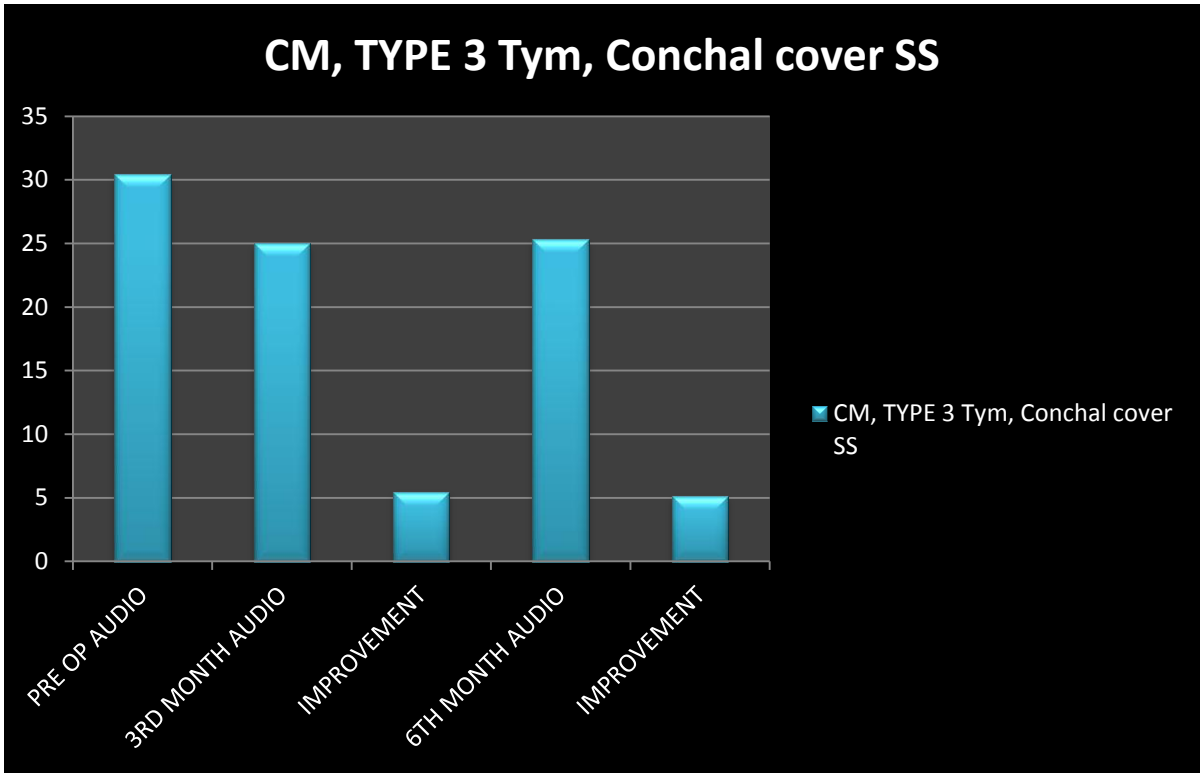

CM, TYPE 2 Tym
45
40
35
30
25
20
15
10
5
0
PRE OP AUDIO
3RD MONTH AUDIO
IMPROVEMENT
6TH MONTH AUDIO
IMPROVEMENT
CM, TYPE 2 Tym

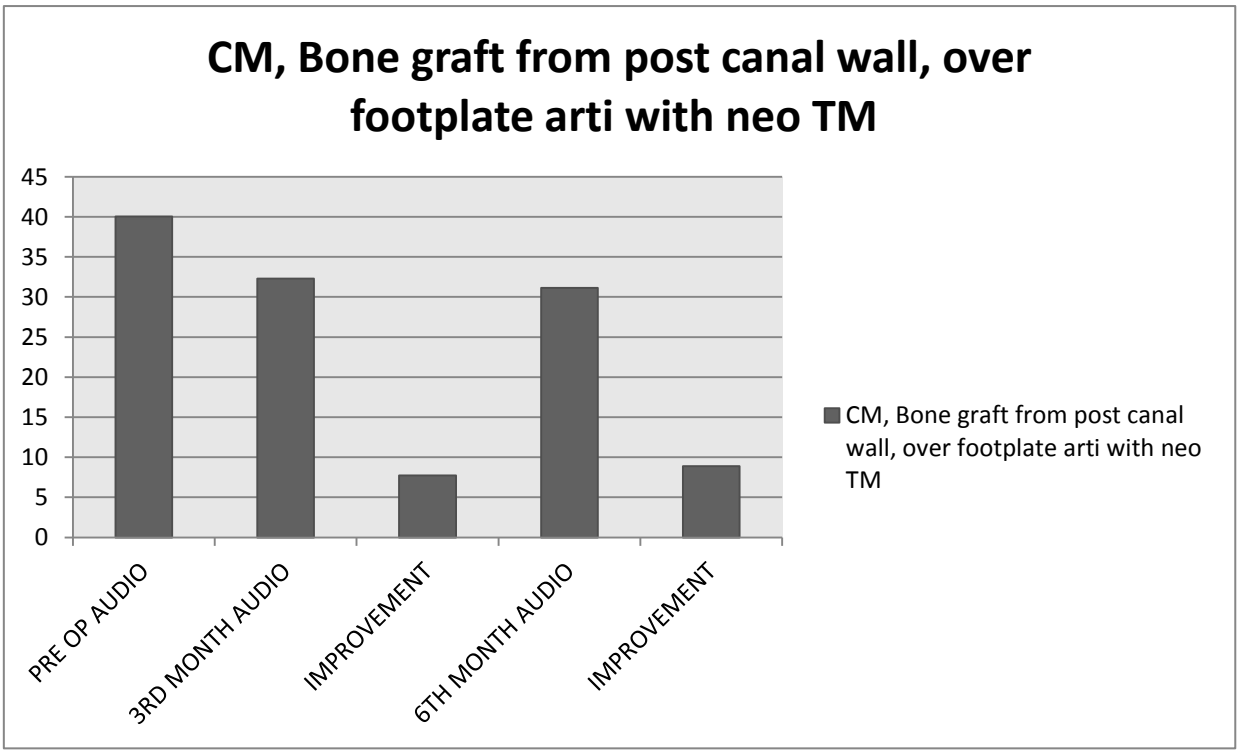

CM, I reshaped between SS and neo TM
50
45
40
35
30
25
20
15
10
5
0
PRE OP AUDIO
3RD MONTH AUDIO
IMPROVEMENT
6TH MONTH AUDIO
IMPROVEMENT
CM, I reshaped between SS and neo TM

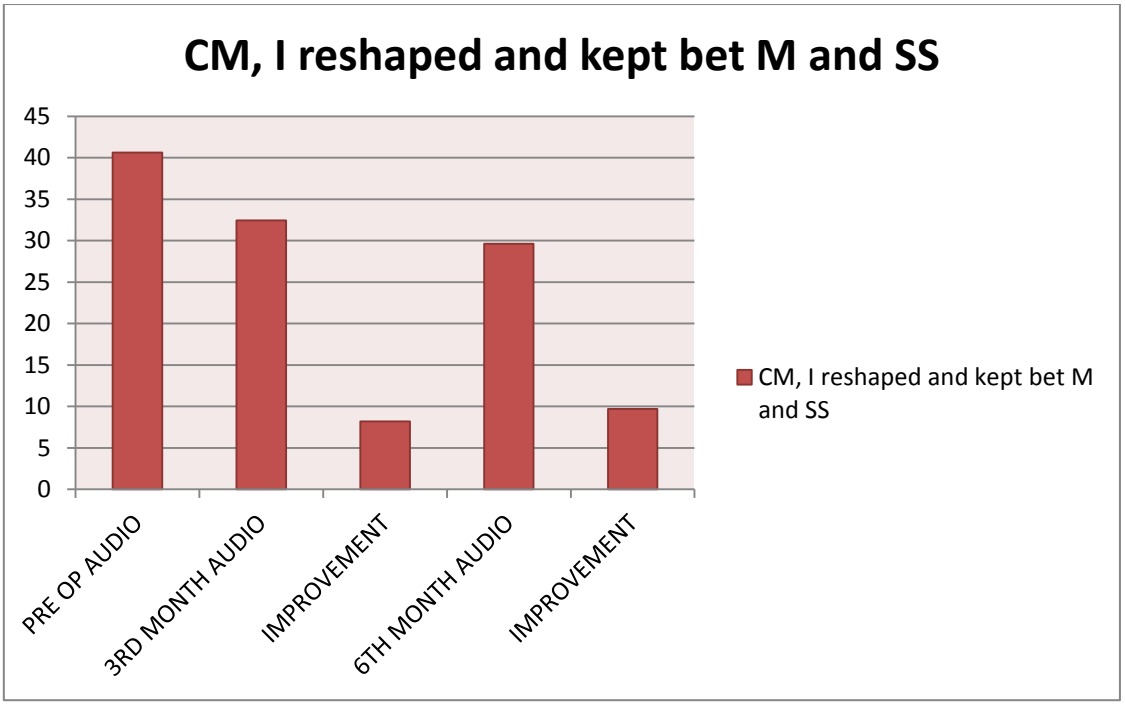

CM, M reshaped between SS and neo TM
50
45
40
35
30
25
20
15
10
5
0
PRE OP AUDIO
3RD MONTH AUDIO
IMPROVEMENT
6TH MONTH AUDIO
IMPROVEMENT
CM, M reshaped between SS and neo TM

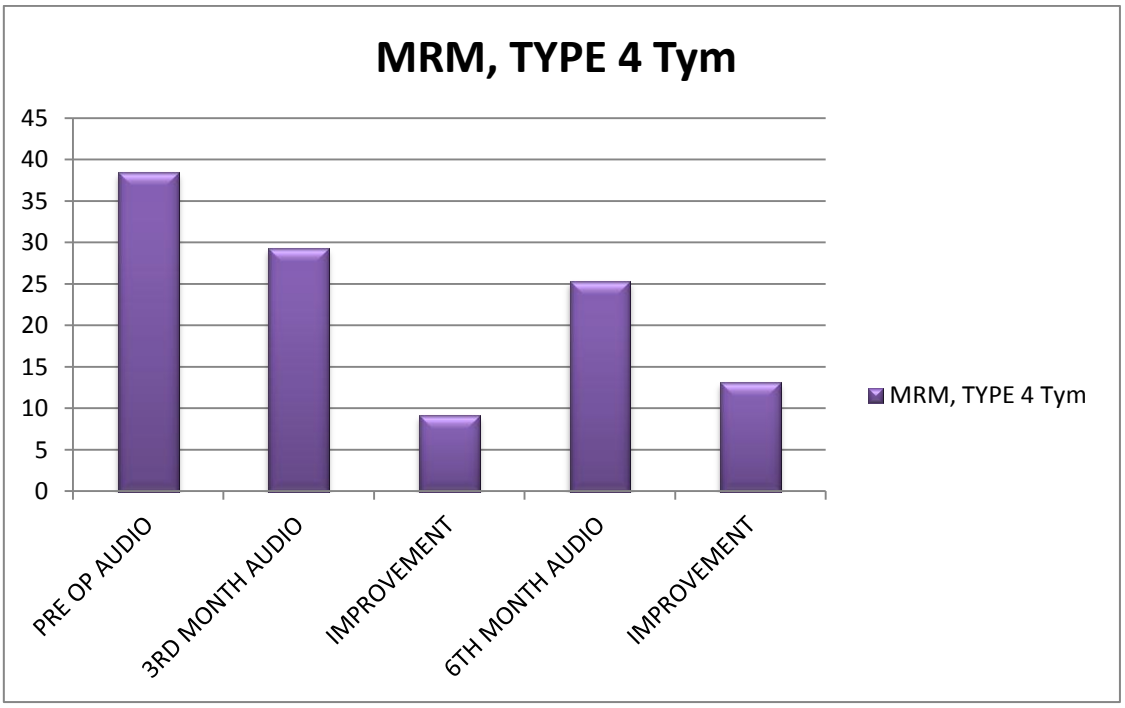

MRM, TYPE 3 Tym
40
35
30
25
20
15
10
5
0
PRE OP AUDIO
3RD MONTH AUDIO
IMPROVEMENT
6TH MONTH AUDIO
IMPROVEMENT
MRM, TYPE 3 Tym


CM, TYPE 3 Tym
40
35
30
25
20
15
10
5
0
PRE OP AUDIO
3RD MONTH AUDIO
IMPROVEMENT
6TH MONTH AUDIO
IMPROVEMENT
CM, TYPE 3 Tym


CM, TYPE 3 Tym, Conchal cover SS
35
30
25
20
15
10
5
0
PRE OP AUDIO
3RD MONTH AUDIO
IMPROVEMENT
6TH MONTH AUDIO
IMPROVEMENT
CM, TYPE 3 Tym, Conchal cover SS


CM, Bone graft from post canal wall, over footplate arti with neo TM
45
40
35
30
25
20
15
10
5
0
PRE OP AUDIO
3RD MONTH AUDIO
IMPROVEMENT
6TH MONTH AUDIO
IMPROVEMENT
CM, Bone graft from post canal wall, over footplate arti with neo TM

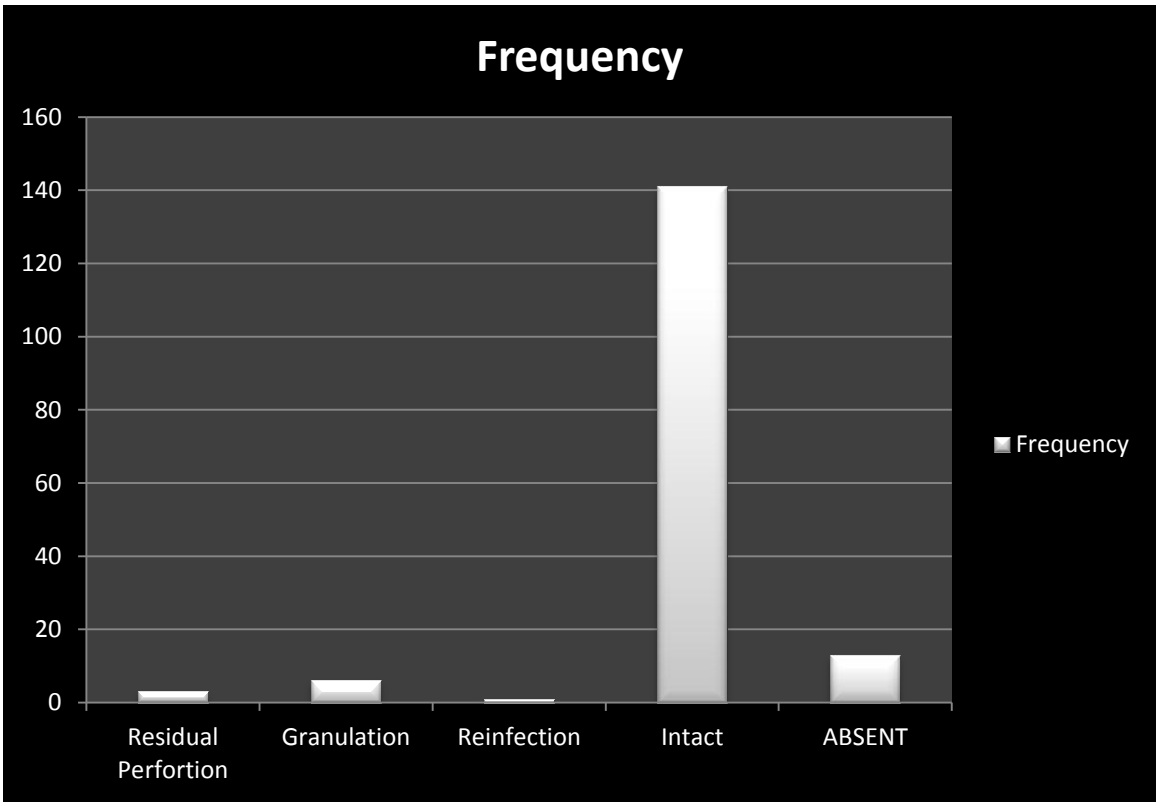

CM, I reshaped and kept bet M and SS
45
40
35
30
25
20
15
10
5
0
PRE OP AUDIO
3RD MONTH AUDIO
IMPROVEMENT
6TH MONTH AUDIO
IMPROVEMENT
CM, I reshaped and kept bet M and SS

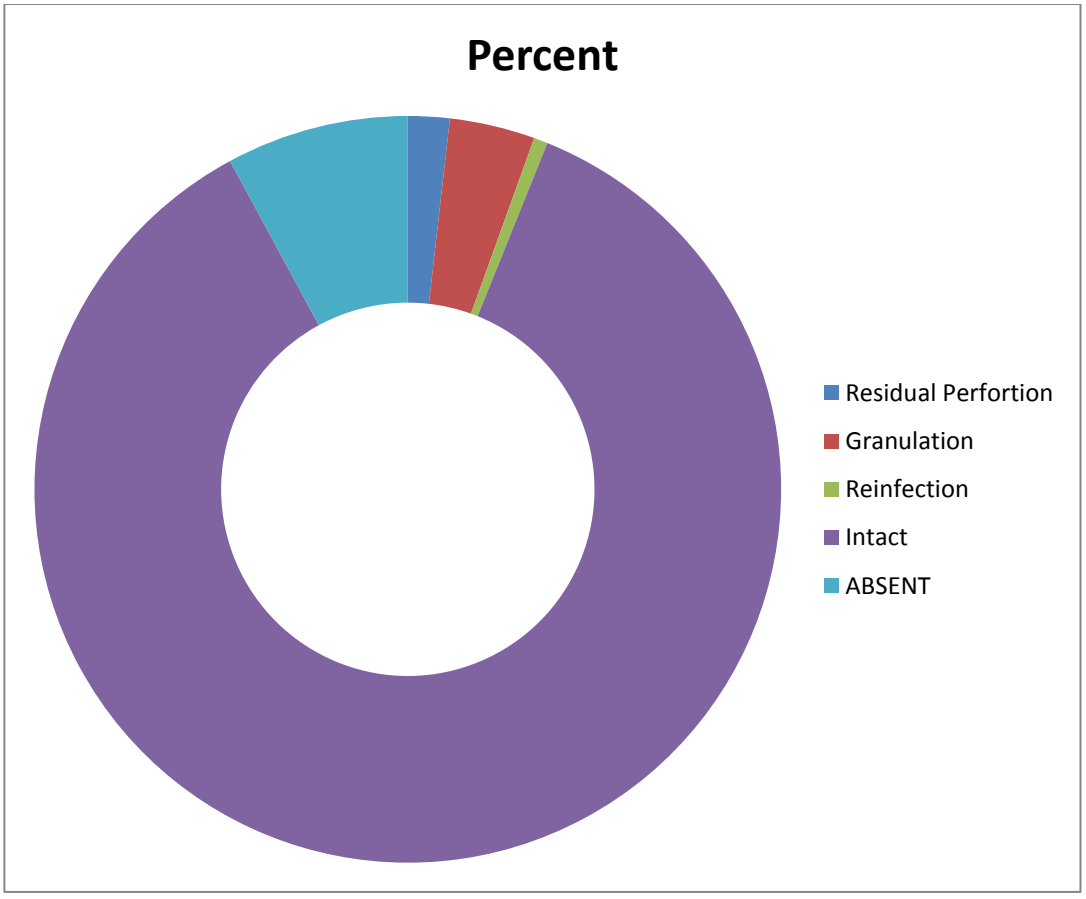

MRM, TYPE 4 Tym
45
40
35
30
25
20
15
10
5
0
PRE OP AUDIO
3RD MONTH AUDIO
IMPROVEMENT
6TH MONTH AUDIO
IMPROVEMENT
MRM, TYPE 4 Tym

Follow up finding

3rd month			6th month	
	Frequency	Percent	Frequency	percent
Residual Perforation	3	1.8	8	4.9
Granulation	6	3.7	3	1.8
Reinfection	1	.6	9	5.5
Intact	141	86.0	126	76.8
ABSENT	13	7.9	18	11.0

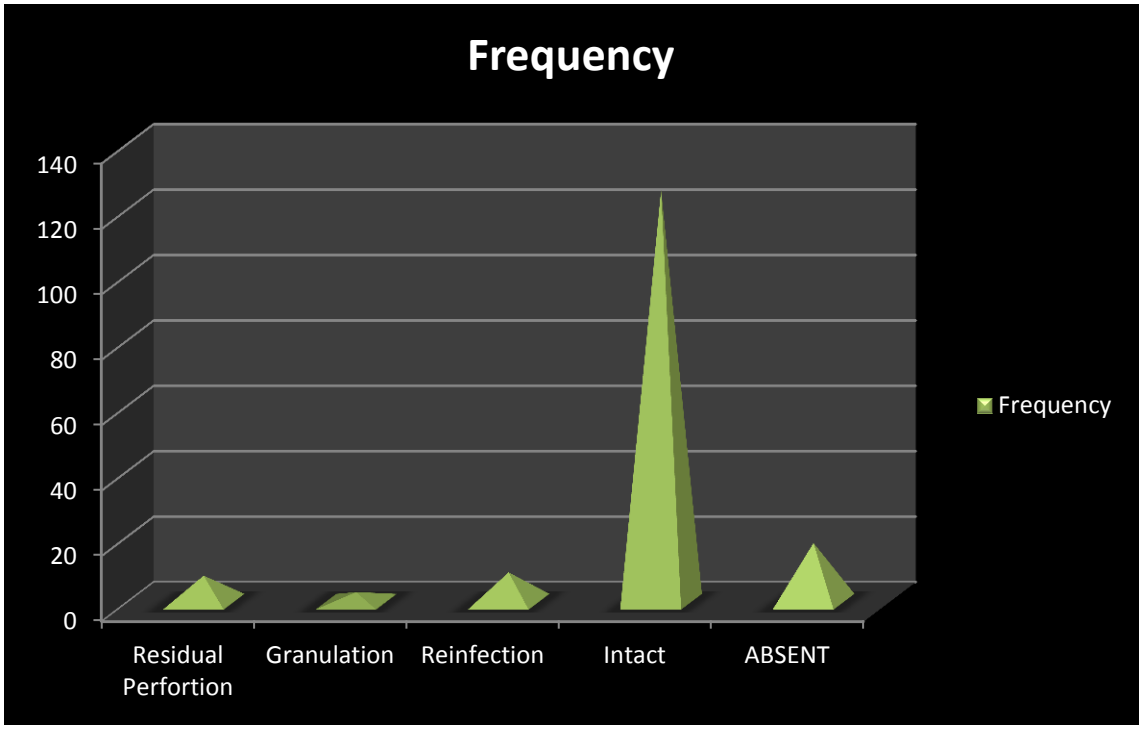
3rd month

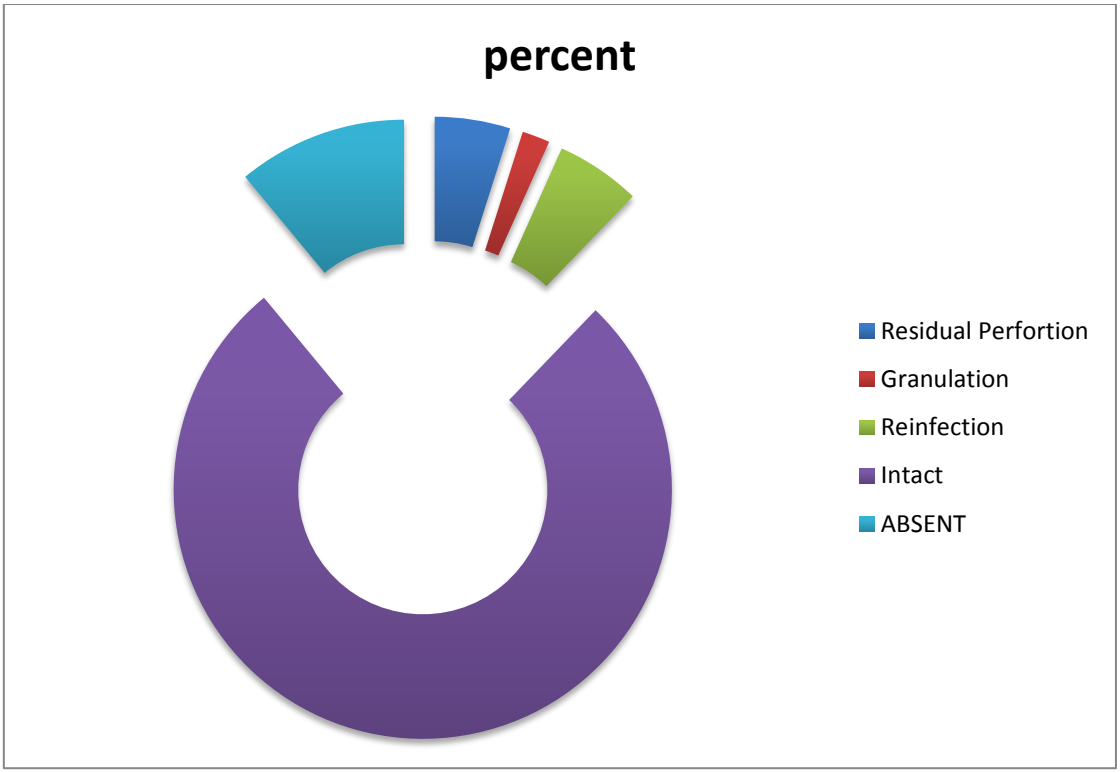

Frequency
160
140
120
100
80
60
40
20
0
Residual Perfortion
Granulation
Reinfection
Intact
ABSENT
Frequency


Percent
Residual Perfortion
Granulation
Reinfection
Intact
ABSENT

In the 3rd month follow up, 86% was the success rate in graft uptake in my institution , as these patients had intact TM. 1.8% percentage were identified with residual perforation. Reinfection was seen in 0.6%. 7.9% patients did not turn for 3rd month follow up. 3.7% patinets were identified with external auditory canal granulations.

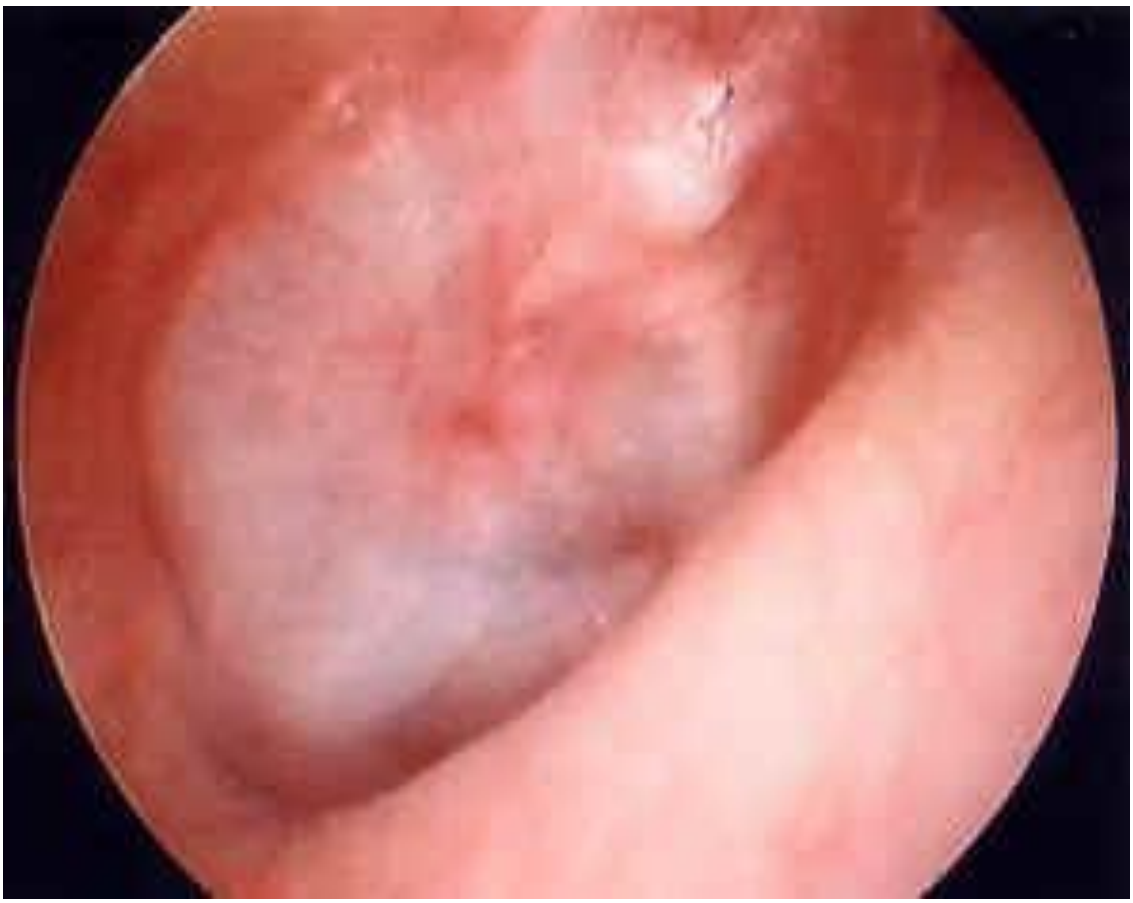
6th month



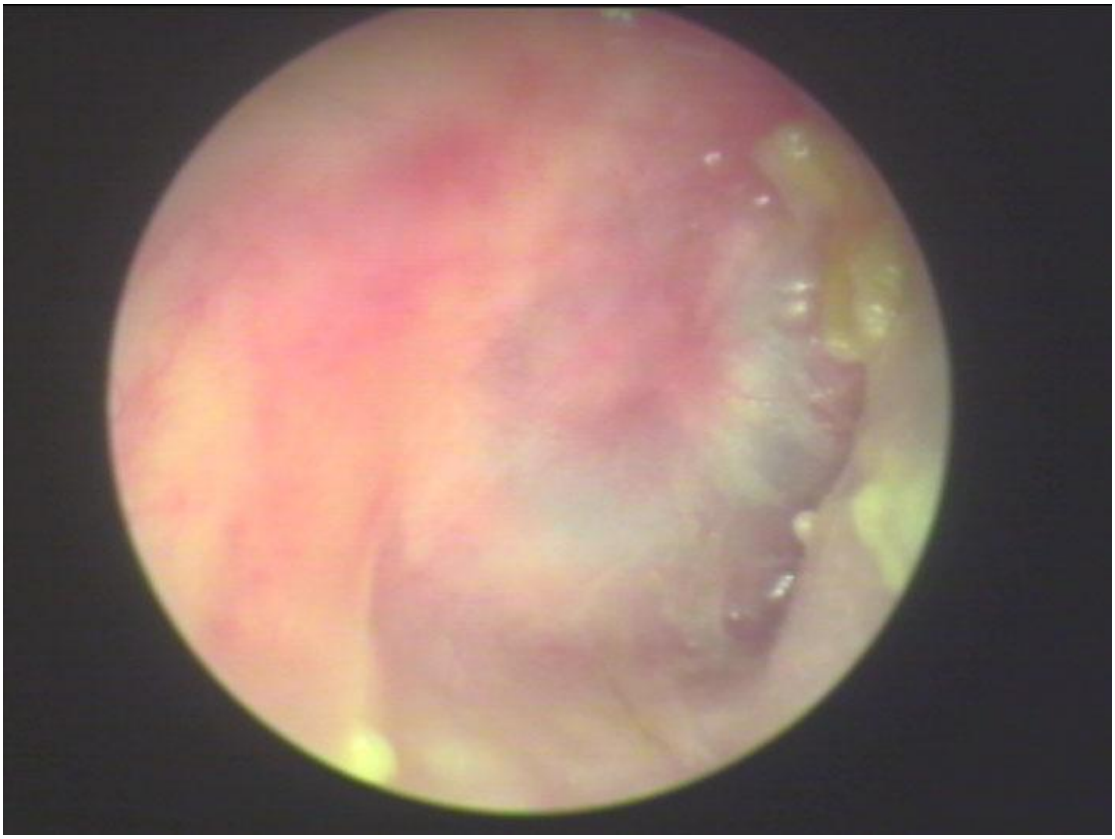


In 6th month follow up, 76.8% patients had intact TM. 11% patients were absent in 6th month follow up. This increase in percentage of patients who didn't turn up for 6th month follow up may be the reason for slight fall in success rate in 6th month compared to 4th month, because people wil intact TM may not turn up for further follow up. Reinfection group has increased from 0.6% to 5.5%. This increase in reinfection of the ear may be due to Eustachian tube dysfunction, poor postop care by the patients, use of ear buds in postop ears by patients himself to clear the post op secretions. This increase in reinfection may also contribute to the slight fall in success rate when we compare the success rate between 3rd and 6th month. 4.9% patients had residual perforation and 1.5 patients had external auditory canal granulations

6^{th} month postop otoscopic view after cortical mastoidectomy with Type I tympanoplasty



6th month follow up



CONCLUSION

- In this study of 164 patients, the predominant type of csom was mucosal type (149).
- The male/ female ratio existing in our patients was 59.1 : 40.9.
- Presentation with unilateral disease (79.9%) is seen more than with bilateral.
- Among unilateral disease, side of ear work up resulted in predominance in left ear.
- Among the pre-op otoscopic examination results, the most common type of tympanic membrane perforation was subtotal perforation (43.2%), followed by perforation being small all quadrant central perforation (20.1%).
- Among the csom squamous type, Posterosuperior quadrant retraction pocket was the most common presentation and attic perforation was the least common presentation.
- Most common ossicle to erode in csom cases is long process of incus(24.4%). Malleus and stapes have a comparable result in case of erosion and they were found to be more resistant in erosion during the pathogenesis of csom.
- All ossicles were found to be eroded more in unsafe csom than in safe csom. Cortical mastoidectomy with type 1 tympanoplasty was

the most common surgery performed among these cases. It recorded a mean improvement of 11.30 db in 6th month post op audiological improvement.

- An improvement of 18.35 db is seen in cases where malleus was reshaped and articulated with stapes. This proves that autografts still holds good in ossiculoplasty
- Loss of 8.30db was observed in case where cortical mastoidectomy with ttype 1 tympanoplasty was done along with conchal cartilage kept medial to temporalis fascia graft.
- In the 3rd month follow up, success rate of tympanoplasty is 86% . 1.8% patients had residual perforation where as 3.7% patients had external auditory canal granulations. Re-infection is reported only in 0.6% cases.7.9% cases were absent from their 3rd month follow up .
- In 6 months follow up, worked up success rate is 76.8%. This fall in success rate compared to 3rd month can be attributed to increase in reinfection(5.5%) and increase in people who didn't turn up for 6th month follow up(11%).
- MERI score and OOPSI was used in this study. Results are showing that cases with high MERI Score and OOPSI have greater chances of ossicular erosion and thus requiring some form of ossiculoplasty as management.

ABBREVATIONS USED

L	Left
R	Right
B/L	Bilateral
CP	Small all quadrant central perforation
ST	Subtotal perforation
Attic P	Attic perforation
Grade 4 RET	Grade 4 Retraction
PSR	PosteroSuperior Retraction pocket
CM	Cortical Mastoidectomy
MRM	Modified Radical Mastoidectomy
Tym	Tympanoplasty
Conchal C	Conchal Cartilage
I	Incus
M	Malleus

SS	Suprastructure of Stapes
arti	articulation
Audio	audiogram

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Annexure 1

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Annexures 2

MASTER CHART

Annexure 3

Consent

Informed patient's consent / Surrogate's Consent

I have been explained in detail about the study that is being carried out. I have also been explained about the possible benefits and harms of using the details in my case sheets.

I have no objection to share the details and investigation reports and would co-operate for the study. I have been informed that I will not be sharing any incentives. Personal identity will not be revealed but the details of data can be used for dissertation/publication purposes.

During the discussion with the physician, at any time, there has been no compulsion to furnish the details and hence the willingness to participate in the study is completely voluntary.

Patient's Signature.

Surrogate's Signature.

MASTER CHART

Sl No	Name	Age	Sex	IP No	Side	Rt Ear	Lt Ear	Ear of surgery	Malleus	Incus	Stapes	MERI	OOposteriorl	Preop Rt Ear	Preop Lt Ear	Surgical Process	TM finding on 3rd month review	6th month review	Rt Ear PTA 3rd month	LT Ear PTA 3rd month	Rt ear PTA 6th month	Lt Ear PTA 6th month
1	Murugan	21	M	44522	R	PSR	INTACT	R	Handle eroded	Long process eroded	Intact	7	7	50	18	MRM, TYPE 3 Tym	INTACT	INTACT	32	18	30	18
2	Micheal Raj	27	M	44074	L	posterior	INTACT	R	Intact	Intact	Intact	2	1	46.6	63.3	CM, TYPE 1 Tym	INTACT	INTACT	45	56	46	58
3	Kokila	23	F	42984	B/L	PSR	posterior	R	Intact	Intact	Intact	3	3	40	36	MRM, TYPE 1 Tym, Conchal C Under the handle	INTACT	INTACT	34	36	31.2	38
4	Thirukottiappan	40	F	43315	L	INTACT	ST	L	Intact	Long process eroded	Intact	4	1	16	38.6	CM,M reshaped and placed over SS	INTACT	INTACT	15	24	16	22
5	Karuppayee	35	F	44798	B/L	ST	ST	L	Intact	Intact	Intact	2	1	30	42	CM, TYPE 1 Tym	INTACT	Reinfection	32	18.6	32	18
6	Essakimuthu	27	M	45530	B/L	posterior	anterior	L	Intact	Intact	Intact	3	2	23.3	43.3	CM, TYPE 1 Tym	INTACT	INTACT	26	26	26	24
7	Alaganteriorampy	64	M	45524	B/L	CP	CP	R	Intact	Intact	Intact	1	1	70	58.6	CM, TYPE 1 Tym	INTACT	INTACT	70	62	A	A
8	Kamatchi	25	F	45797	L	INTACT	CP	L	Intact	Intact	Intact	1	1	25	51.6	CM, TYPE 1 Tym	INTACT	INTACT	25	25	26	23
9	Ramalekshmi	39	F	34516	R	CP	INTACT	R	Intact	Intact	Intact	1	1	46	18.6	CM, TYPE 1 Tym	INTACT	INTACT	23	18	22	18
10	Paranteriorakthi	17	F	35895	L	INTACT	anterior	L	Intact	Intact	Intact	1	1	20	46.6	CM, TYPE 1 Tym	INTACT	INTACT	18	28	20	26
11	Kameela Riswana	13	F	36964	R	ST	INTACT	R	Intact	Long process eroded	Intact	3	4	36.6	15	CM,M reshaped and placed over SS	A	A	A	A	A	A
12	Saravanakrishnan	17	M	37487	R	Attic P	INTACT	R	Head and handle eroded	Long process eroded	Intact	7	7	40	16	MRM, TYPE 3 Tym	INTACT	INTACT	23	16	15	18
13	Rajammal	52	F	38819	R	CP	INTACT	R	Intact	Intact	Intact	4	3	36.6	16	CM, I reshaped and kept bet M and SS	INTACT	INTACT	27	16	25	15.3
14	Seyad Fathima	40	F	38400	L	INTACT	CP	L	Intact	Intact	Intact	2	1	15.3	30	CM, TYPE 1 Tym	INTACT	INTACT	15	26.6	15	26
15	Seethalakshmi	15	F	38833	R	anterior	INTACT	R	Intact	Intact	Intact	1	1	36.6	18	CM,TYPE 1 Tym	INTACT	INTACT	23	16.6	21.3	16
16	Murugesan	30	M	39825	L	INTACT	posterior	L	Intact	Intact	Intact	1	1	16	33.6	CM, TYPE 1 Tym	INTACT	INTACT	16	22	16.6	21.6
17	Mariye Vijanterior	16	M	40356	L	INTACT	CP	L	Intact	Intact	Intact	4	4	21	45	CM, TYPE 1 Tym	R CP	R CP	18	42	18	48
18	Bethammal	55	F	41432	L	INTACT	CP	L	Intact	Intact	Intact	3	1	26	43	CM, TYPE 1 Tym	INTACT	INTACT	26	40	24	39
19	Sulegka	34	F	40321	L	INTACT	posterior	L	Intact	Intact	Intact	3	3	15	38	CM, I reshaped and kept bet M and SS	INTACT	INTACT	16	32	16	30
20	Karpaganteriorelvi	20	F	39959	R	CP	INTACT	R	Intact	Long process eroded	Intact	6	6	46	16.6	CM, TYPE 3 Tym	R CP	R CP	28	16	24	16
21	Gayathri	9	F	41383	R	PSR	INTACT	R	Handle eroded	Long process eroded	Suprastructure eroded	7	7	38.6	13.3	MRM, bone graft from post canal wall, over footplate	Granulation	Granulation	34	15	36	15
22	Byroja	35	F	41379	R	CP	INTACT	R	Intact	Intact	Intact	1	1	36	14	CM, TYPE 1 Tym	INTACT	INTACT	26	14	22	15
23	Muthulekshmi	16	F	41868	R	PSR	INTACT	R	Handle eroded	Long process eroded	Suprastructure eroded	5	7	40	17	MRM,M reshaped and kept over footplate	INTACT	Reinfection	36	16	32	15
24	Kumar	37	M	42731	R	ST	INTACT	R	Intact	Intact	Intact	2	1	36.6	18	CM, TYPE 1 Tym	INTACT	INTACT	22	18	20	17

25	Shifa Rubi	19	F	42750	B/L	ST	ST	R	Intact	Intact	Intact	3	4	38.6	38	CM, I reshaped and kept bet M and SS	INTACT	A	26	16.6	A	A
26	Krishnanteriorami	22	M	43162	L	INTACT	anterior	L	Intact	Intact	Intact	3	4	16	43.3	CM, TYPE 1 Tym	INTACT	INTACT	16	26	16	23.3
27	Viswanathan	23	M	43210	R	posterior	INTACT	R	Intact	Intact	Intact	1	1	28	16.6	CM, TYPE 1 Tym	INTACT	INTACT	22.6	16.3	21	16
28	Murugan	21	M	44522	R	ST	INTACT	R	Intact	Intact	Intact	3	4	33.3	16	CM, TYPE 1 Tym	INTACT	INTACT	28	16	26.6	15.6
29	Micheal Raj	27	M	44522	R	anterior	INTACT	R	Intact	Intact	Intact	3	2	26	15	CM, TYPE 1 Tym	INTACT	INTACT	26.6	15	28	15.6
30	Anthonyammal	42	F	44565	L	INTACT	ST	L	Intact	Long process eroded	Intact	4	4	18	45	CM, I reshaped and kept bet M and SS	Granulation	INTACT	16	48	15.6	46.6
31	Maheswari	13	F	45003	L	INTACT	CP	L	Intact	Intact	Intact	1	1	18	38	CM, TYPE 1 Tym	INTACT	INTACT	18	23	16	21
32	Alaganterioramy	64	M	45524	B/L	CP	anterior	R	Intact	Long process eroded	Intact	7	6	45	32	CM, M reshaped and kept over SS	INTACT	INTACT	28	33	25	32
33	Muthukumar	26	M	48861	R	ST	INTACT	R	Intact	Long process eroded	Intact	4	4	36	16.6	CM, I reshaped and kept bet M and SS	Granulation	INTACT	29	16	24	16.6
34	Shanmugam	33	F	48654	R	posterior	INTACT	R	Intact	Intact	Intact	1	1	28	15	CM, TYPE 1 Tym	INTACT	INTACT	22	16	22	15
35	Pandi	43	M	49510	L	INTACT	ST	L	Intact	Intact	Intact	1	1	16	36.6	CM, TYPE 1 Tym	INTACT	INTACT	15	24	15	23
36	Selvaganesan	32	M	50007	R	ST	INTACT	R	Intact	Long process eroded	Intact	4	5	56	23	CM, I reshaped and kept bet M and SS	INTACT	A	32	21	A	A
37	Sivarama Nambi	38	M	50929	B/L	ST	INTACT	R	Handle eroded	Long process eroded	Intact	7	6	43	16.6	CM. TYPE 3 Tym	INTACT	INTACT	36	16.6	33	16.6
38	Vijayalekshmi	27	F	50427	L	INTACT	CP	L	Intact	Intact	Intact	1	1	18.3	42	CM, TYPE 1 Tym	INTACT	INTACT	16	24	16	22
39	Petchiammal	22	F	50446	L	INTACT	anterior	L	Intact	Intact	Intact	1	1	16.6	36	CM, TYPE 1 Tym	INTACT	INTACT	16	21	16.6	24
40	Mohammed Hydros	36	M	52261	L	INTACT	AURAL P	L	Handle eroded	Long process eroded	Supranteriortructure eroded	7	7	16.6	54	MRM, TYPE 4 Tym	Reinfection	INTACT	16	26	16.6	23.3
41	Mohammed Nanteriorurade en	35	M	41003	R	ST	INTACT	R	Intact	Intact	Intact	1	4	38	23	CM, TYPE 1 Tym	A	A	A	A	A	A
42	David dharmanteriore elan	40	M	42010	L	INTACT	ST	L	Intact	Intact	Intact	2	2	18	55	CM, TYPE 1 Tym	INTACT	INTACT	18	36	18	38.3
43	Manimoli	32	F	41626	L	INTACT	anterior	L	Intact	Intact	Intact	4	6	18	46	CM, TYPE 1 Tym	INTACT	INTACT	18	38	16	36.6
44	Nambiammal	43	F	43420	B/L	ST	ST	L	Intact	Intact	Intact	4	6	56	60	CM, TYPE 1 Tym	INTACT	Reinfection	58	56	56	56.6
45	Rajan	33	M	43766	B/L	ST	ST	R	Intact	Intact	Intact	2	2	60	72	CM, TYPE 1 Tym	INTACT	INTACT	56.6	72	56	74
46	Kokila	23	M	42984	B/L	ST	ST	R	Intact	Intact	Intact	2	2	46	43	CM, TYPE 1 Tym	INTACT	INTACT	28	43	23	44
47	Marimuthu	30	M	45185	L	INTACT	ST	L	Intact	Intact	Intact	2	1	33	56	CM, TYPE 1 Tym	INTACT	INTACT	33	34	33	26
48	Madhavan	18	M	47199	B/L	ST	ST	L	Intact	Intact	Intact	1	1	36.6	33.3	CM, TYPE 1 Tym	INTACT	INTACT	36.6	21	36	18
49	Srirangan	34	M	48405	B/L	ST	anterior	R	Intact	Intact	Intact	3	4	48	26.6	CM, TYPE 1 Tym	INTACT	INTACT	26	26.6	21	26.6
50	Sivakami	36	F	48365	R	ST	INTACT	R	Intact	Intact	Intact	2	2	33.3	16	CM, TYPE 1 Tym	INTACT	INTACT	22	16	21.3	16.6
51	Murugathal	32	F	49800	L	posterior	INTACT	R	Intact	Long process eroded	Intact	7	6	26	43	CM, TYPE 3 Tym	INTACT	Reinfection	26	38.3	23	42
52	Paul raj	40	M	49805	L	INTACT	ST	L	Intact	Intact	Intact	2	2	17	56	CM, TYPE 1 Tym	INTACT	INTACT	17	27	18	28.3
53	Mahesh	35	M	49860	L	INTACT	ST	L	Intact	Intact	Intact	3	4	16	26.6	CM, TYPE 1 Tym	INTACT	INTACT	16	22	16	22.3
54	Shanmugathanterior	40	F	51215	R	ST	INTACT	R	Intact	Intact	Intact	1	1	46	21	CM, TYPE 1 Tym	INTACT	INTACT	28	18	22	18
55	Sermakani	32	F	51556	L	ST	INTACT	R	Intact	Intact	Intact	2	4	46	18	CM, TYPE 1 Tym	INTACT	R CP	32	18	38	18.6
56	Revathy	46	F	52541	R	ST	INTACT	R	Intact	Intact	Intact	3	2	46.6	23	CM, TYPE 1 Tym	INTACT	INTACT	38	21	36.6	21

57	Mariammal	26	F	52896	B/L	ST	ST	R	Intact	Intact	Intact	3	3	44	39.2	CM, TYPE 1 Tym	INTACT	INTACT	36	39.6	34	39.2
58	Esakkiammal	28	F	55072	R	ST	INTACT	R	Intact	Intact	Intact	2	1	36.6	14	CM, TYPE 1 Tym	INTACT	INTACT	21	15	18	15
59	Padma	30	F	56491	L	INTACT	ST	L	Intact	Long process eroded	Supranter iortructur e eroded	6	5	16.6	26.4	CM, bone graft from post canal wall, over footplate arti with M	INTACT	Reinfectio n	16	26	16.6	26.3
60	Rahmath Beegam	36	F	55550	L	INTACT	GRADE 4 RET	L	Intact	Intact	Intact	1	1	18	31.3	CM, TYPE 1 Tym, Conchal C under the handle	INTACT	INTACT	18	36	18.3	38.6
61	Latha	40	F	46538	L	INTACT	PSR	L	Intact	Long process eroded	Intact	4	4	16.6	32.3	CM, TYPE 3 Tym, Conchal cover SS	INTACT	INTACT	16.6	28	15	26.3
62	Rajakumari	24	F	56854	L	INTACT	ST	L	Intact	Intact	Intact	3	1	13	44.4	CM, TYPE 1 Tym	INTACT	INTACT	13	26	14	24.3
63	Muthuramaling am	40	M	57847	R	ST	INTACT	R	Intact	Intact	Intact	1	1	36.6	18	CM, TYPE 1 Tym	INTACT	A	26	18	A	A
64	Antonyammal	47	F	57254	L	INTACT	ST	L	Intact	Intact	Intact	1	1	16	27.6	CM, TYPE 1 Tym	INTACT	INTACT	16	22	15	21.3
65	Muthukumar	17	M	58208	L	INTACT	ST	L	Intact	Intact	Intact	1	1	16	36.6	CM, TYPE 1 Tym	INTACT	INTACT	16	24	15.6	21.6
66	Shabur nisha	25	F	58262	R	PSR	INTACT	R	Head and handle eroded	Complete ly eroded	-	5	6	28.6	18	MRM, bone graft from post canal wall, over footplate	INTACT	INTACT	27	16	22	16.6
67	Suresh	28	M	58284	L	INTACT	anterior	L	Intact	Long process eroded	Intact	2	4	16	26.4	CM, I reshaped and kept bet M and SS	INTACT	Reinfectio n	15	38	16	37.6
68	Lakshmanaperu mal	62	M	59244	L	INTACT	GRADE 4 RET	L	Intact	Intact	Intact	1	3	16	30	CM, TYPE 1 Tym, Conchal C under the handle	INTACT	INTACT	16	36	16.6	39.3
69	Ajithkumar	16	M	59166	L	INTACT	ST	L	Intact	Intact	Intact	1	1	21	42.6	CM, TYPE 2 Tym	INTACT	INTACT	19	28.6	20	24.3
70	Mohammed Ansar	9	M	59222	L	INTACT	PSR	L	Intact	Long process eroded	Suprastru cture eroded	4	6	16	36.3	MRM, Type 4 Tym	Granulati on	INTACT	15	32	16.33	32.3
71	Ankaleshwari	17	F	59238	L	INTACT	anterior	L	Intact	Intact	Intact	1	1	14	29.3	CM, TYPE 1 Tym	INTACT	INTACT	15	26.6	15.3	24.6
72	Meena	45	F	59969	R	CP	INTACT	R	Intact	Intact	Intact	4	4	46.6	22	CM, TYPE 1 Tym	A	INTACT	A	A	27	18
73	Ponnuthanterio r	45	F	13588	L	ST	INTACT	R	Intact	Intact	Intact	1	1	18	33	CM, TYPE 1 Tym	INTACT	INTACT	18	28	16.6	23.3
74	Madathi	30	F	14017	L	INTACT	ST	L	Intact	Intact	Intact	1	1	16	28.3	CM, TYPE 1 Tym	INTACT	INTACT	16.3	26.3	16	27
75	Santhiappan	23	M	14021	L	INTACT	anterior	L	Intact	Intact	Intact	1	1	20	44	CM, TYPE 1 Tym	INTACT	INTACT	18	28	18.6	23
76	Malathi	21	F	14276	R	ST	INTACT	R	Intact	Intact	Intact	3	2	30	16.6	CM, TYPE 1 Tym	INTACT	A	29.6	18	A	A
77	Puthiya Raj	44	M	13173	B/L	posterior	anterior	R	Intact	Intact	Intact	1	1	33.3	30	CM, TYPE 1 Tym	INTACT	INTACT	26	30	24.6	31.3
78	Jacob Micheal	35	M	15707	R	ST	INTACT	R	Intact	Intact	Intact	3	2	33.3	15	CM, TYPE 1 Tym	R CP	R CP	36	16.6	33.3	16
79	Rani	31	F	15692	R	CP	INTACT	R	Intact	Intact	Intact	1	1	36	18	CM, TYPE 1 Tym	INTACT	INTACT	23	18	22.6	18.6
80	Suryakala	15	F	15281	R	ST	INTACT	R	Intact	Intact	Intact	4	3	28	15	CM, TYPE 1 Tym	INTACT	INTACT	26.6	15.3	22	16
81	Pappa	33	F	16778	B/L	CP	ST	L	Intact	Intact	Intact	2	2	33	36	CM, TYPE 1 Tym	INTACT	INTACT	33	22	34.3	21.6
82	Sivakumar	60	M	15720	B/L	anterior	CP	L	Intact	Intact	Intact	1	1	30	38.6	CM, TYPE 1 Tym	INTACT	A	30	26	A	A
83	Sornamathi	23	F	17684	R	CP	INTACT	R	Intact	Intact	Intact	4	2	26	16.6	CM, TYPE 1 Tym	INTACT	INTACT	24	16	24.3	16
84	Hanterioreena	16	F	18227	R	CP	INTACT	R	Intact	Intact	Intact	4	2	36	16	CM, TYPE 1 Tym	INTACT	INTACT	33.3	15	24	16
85	Shankar	17	M	18250	L	INTACT	ST	L	Intact	Intact	Intact	1	1	22.3	33.3	CM, TYPE 1 Tym	INTACT	INTACT	21	28.3	22	26
86	Thangamani	31	F	17258	R	posterior	INTACT	R	Intact	Intact	Intact	1	1	28	18	CM, TYPE 1 Tym	INTACT	INTACT	26	16	22.4	16.6
87	Essakiammal	45	F	18283	B/L	anterior	CP	L	Intact	Intact	Intact	1	1	26	33	CM. TYPE 1 Tym	INTACT	INTACT	26	24.3	24.3	21
88	anteriorankani	52	M	19804	B/L	posterior	posterior	R	Intact	Intact	Intact	1	1	23.3	26.6	CM, TYPE 1 Tym	INTACT	INTACT	22	24.3	21.3	24
89	Jeba	19	F	19711	B/L	anterior	CP	L	Intact	Intact	Intact	1	1	26	28	CM, TYPE 1 Tym	INTACT	INTACT	21.3	28	21.6	26.6
90	Shanmugathant erior	40	F	20231	R	posterior	INTACT	R	Handle eroded	Long process eroded	Intact	7	4	33.3	16	CM, TYPE 3 Tym	INTACT	R CP	30.6	15.3	38.3	16

91	Dhanalekshmi	17	F	20228	R	CP	INTACT	R	Intact	Intact	Intact	3	4	33.3	15	CM, TYPE 1 Tym	INTACT	INTACT	28.6	16.6	24	15.3
92	Thangammal	41	F	20300	R	posterior	INTACT	R	Intact	Intact	Intact	3	2	26	15	CM, TYPE 1 Tym	INTACT	INTACT	28.3	13.3	23.6	14
93	Muthulekshmi	23	F	20764	R	CP	INTACT	R	Intact	Long process eroded	Intact	5	3	44	15.3	CM, I reshaped and kept bet M and SS	INTACT	INTACT	24.3	14.3	22.3	15
94	Sankarammal	49	F	20238	R	posterior	INTACT	R	Intact	Long process eroded	Intact	5	3	46	16	CM, M reshaped between SS and neo TM	INTACT	INTACT	28.3	15	26.6	14.3
95	Ganapathi	35	F	21416	L	INTACT	ST	L	Intact	Long process eroded	Intact	7	6	18	53	CM, TYPE 3 Tym	INTACT	Reinfectio n	16.6	36.6	15	38
96	Subbulekshmi	27	F	21435	L	INTACT	CP	L	Intact	Intact	Intact	2	2	15	38	CM, TYPE 1 Tym	INTACT	INTACT	15	23	15	25.3
97	Lakshmi	28	F	24167	R	ST	INTACT	R	Intact	Long process eroded	Intact	7	7	40	18.6	MRM, TYPE 3 Tym	INTACT	Granulati on	26	18	23	16.6
98	Mariammal	17	F	25690	L	INTACT	posterior	L	Intact	Long process eroded	Intact	6	6	20	43.3	CM, M reshaped between SS and neo TM	INTACT	INTACT	18.3	28.6	18	26
99	Mohammed Irman Kani	30	M	25674	L	INTACT	ST	L	Intact	Intact	Intact	1	1	21	36	CM, TYPE 1 Tym	INTACT	INTACT	21	28	20	28.6
100	Vanteriorantha	30	F	26328	B/L	posterior	anterior	L	Intact	Long process eroded	Suprastru cture eroded	8	6	33	36	CM, Bone graft from post canal wall, over footplate arti with neo TM	INTACT	INTACT	33	26	33	23
101	Maharajan	13	M	29610	L	INTACT	ST	L	Intact	Long process eroded	Intact	3	3	18.6	43.3	CM, I reshaped and kept bet M and SS	INTACT	INTACT	16.6	26	16	24.3
102	Parvathy	28	F	29575	B/L	ST	anterior	R	Intact	Long process eroded	Intact	5	6	43.3	38.6	CM, I reshaped and kept bet M and SS	INTACT	A	28.6	38.6	A	A
103	Selvi	40	F	25979	B/L	ST	ST	L	Intact	Intact	Intact	2	1	46.6	42.6	CM, TYPE 1 Tym	INTACT	INTACT	33.3	42	30.6	42.3
104	Nambiammal	55	M	29580	B/L	posterior	CP	L	Intact	Intact	Intact	1	1	28.6	31.3	CM, TYPE 1 Tym	INTACT	INTACT	28.6	24	30	22.6
105	Rama	47	F	30565	L	INTACT	CP	L	Handle eroded	Long process eroded	Suprastru cture eroded	8	6	16.6	44.1	CM, Bone graft from post canal wall, over footplate arti with neo TM	INTACT	INTACT	15.3	38.6	16.6	39.3
106	Kavitha	23	F	30574	L	INTACT	anterior	L	Intact	Intact	Intact	1	1	16	26.6	CM, TYPE 1 Tym	INTACT	INTACT	16	23.3	16.3	21
107	Essakiraj	22	M	31215	L	INTACT	anterior	L	Intact	Intact	Intact	1	1	16.3	31.2	CM, TYPE 1 Tym	INTACT	INTACT	16.3	24	15	22.6
108	Saravanan	18	M	31636	B/L	anterior	posterior	L	Intact	Intact	Intact	2	1	29.7	36.3	CM. TYPE 1 Tym	INTACT	INTACT	28.6	24	29.2	21.3
109	Murugalekshmi	23	F	31218	R	INTACT	CP	L	Intact	Intact	Intact	2	3	15	38.6	CM, TYPE 1 Tym	INTACT	INTACT	15.3	23	15	25
110	Ramalekshmi	28	F	31208	B/L	CP	ST	L	Intact	Intact	Intact	2	1	31.3	48.6	CM, TYPE 1 Tym	INTACT	INTACT	31.3	36.3	30.6	38.6
111	Chinnapandi	49	M	29330	R	ST	INTACT	R	Intact	Intact	Intact	2	3	46.6	13.3	CM, TYPE 1 Tym	INTACT	R CP	34.3	13.6	33.3	13.3
112	Petchiappan	25	M	30925	R	ST	INTACT	R	Intact	Intact	Intact	4	4	38.6	15.5	CM, TYPE 1 Tym	INTACT	INTACT	28.3	15.6	26	14.3
113	Premadevi	29	F	23329	L	INTACT	anterior	L	Intact	Intact	Intact	4	4	14.3	38.6	CM, TYPE 1 Tym	INTACT	INTACT	15.3	24.6	15	21
114	Porselvi	42	F	23317	R	anterior	INTACT	R	Intact	Intact	Intact	1	1	41.2	18.6	CM, TYPE 1 Tym	INTACT	INTACT	32.6	16.6	28.4	16.3
115	Kanteriorthuri	16	F	23361	R	CP	INTACT	R	Intact	Intact	Intact	3	4	28.6	14.3	CM, TYPE 1 Tym	INTACT	INTACT	22.4	15	21.3	15
116	Nanteriorarath Beegam	17	F	27666	L	INTACT	ST	L	Intact	Intact	Intact	2	1	18.6	38.6	CM, TYPE 1 Tym	A	A	A	A	A	A
117	Sivanandini	15	F	29840	R	anterior	INTACT	R	Intact	Long process eroded	Intact	7	5	28.6	15	CM, TYPE 3 Tym, Conchal C over SS	INTACT	INTACT	22	13	24.3	13.3
118	Muthukumar	15	M	28276	L	INTACT	posterior	L	Intact	Intact	Intact	1	1	16	26.6	CM, TYPE 1 Tym	INTACT	INTACT	15	21	15.3	21.6

119	Ramalekshmi	39	F	34516	R	posterior	INTACT	R	Intact	Long process eroded	Suprastructure eroded	8	6	28.3	16	MRM, TYPE 4 Tym	Granulation	INTACT	27	15	20.6	15.3
120	Maheswari	18	F	35907	L	INTACT	posterior	L	Intact	Intact	Intact	1	1	35	14.3	CM, TYPE 1 Tym	INTACT	INTACT	28.3	14	26	14.6
121	Lakshmi	30	F	60827	L	INTACT	ST	L	Intact	Intact	Intact	1	1	13.5	32.6	CM, TYPE 1 Tym	A	A	A	A	A	A
122	Arumugam	43	F	62265	R	CP	INTACT	R	Intact	Intact	Intact	3	4	44	21.3	CM, TYPE I Tym	INTACT	INTACT	36.3	21.3	28.6	20.6
123	Thavuth NishA	24	F	61866	R	GRADE 4 RET	INTACT	R	Intact	Intact	Intact	3	3	33	16.6	CM, M reshaped between SS and neo TM, Conchal C over M	A	A	A	A	A	A
124	Kalanterior Santhanamari	26	F	61853	L	INTACT	anterior	L	Intact	Intact	Intact	1	1	14	34.3	CM, TYPE 1 Tym	INTACT	INTACT	14	26.3	13.3	22.3
125	Thiravidamani	55	M	61848	B/L	ST	ST	R	Intact	Intact	Intact	5	4	38.3	42.6	CM, TYPE 1 Tym	INTACT	INTACT	28.3	42.6	24	42
126	anteriorarath	19	M	61817	B/L	anterior	anterior	L	Handle eroded	Long process eroded	Suprasrtructure eroded	8	6	28.6	31.3	CM, M reshaped between footplate and neo TM, Conchal C over M	INTACT	INTACT	28	26	23	26.3
127	Manorathi	37	F	64421	L	INTACT	ST	L	Intact	Intact	Intact	2	2	18.6	46.6	CM, TYPE 1 Tym	INTACT	INTACT	18.6	32	18	28.6
128	Sahayam	47	M	64531	L	INTACT	ST	L	Handle eroded	Long process eroded	Intact	4	4	16	41.3	CM, I reshaped and kept bet M and SS	INTACT	INTACT	16	28.6	16.3	26
129	Sumathy	38	F	53935	L	INTACT	anterior	L	Handle eroded	Long process eroded	Suprastructure eroded	8	6	14.6	38.6	CM, M reshaped between footplate and neo TM, Conchal C over M	INTACT	INTACT	15	32.6	14.7	28.4
130	Parvathy	42	F	53950	L	INTACT	anterior	L	Intact	Intact	Intact	1	1	16	36	CM, TYPE 1 Tym	INTACT	INTACT	16	21	16.3	21.6
131	Jeya	43	F	54819	L	INTACT	CP	L	Intact	Intact	Intact	1	1	16.6	31.3	CM, TYPE 1 Tym	A	A	A	A	A	A
132	Mariappan	20	M	55216	L	INTACT	ST	L	Intact	Intact	Intact	1	1	16.6	38.3	CM, TYPE 1 Tym	A	A	A	A	A	A
133	Sekar	33	M	54769	B/L	ST	ST	R	Handle eroded	Intact	Intact	2	2	36.3	34.3	CM, TYPE 1 Tym	INTACT	INTACT	30	36.3	28.3	35.3
134	Mahesh	18	M	54820	R	ST	INTACT	R	Intact	Intact	Intact	1	1	40.6	16.6	CM, TYPE 1 Tym	INTACT	Reinfection	28	15	26.3	15.3
135	Chandran	32	M	65979	L	INTACT	CP	L	Intact	Intact	Intact	3	2	16	44	CM, TYPE 1 Tym	INTACT	INTACT	16	34	16.3	26.3
136	Ponmadanteriorami	40	M	66416	B/L	ST	ST	R	Intact	Intact	Intact	1	1	76	67	CM, TYPE 1 Tym	INTACT	INTACT	70	70.3	72.3	72
137	Lakshmi	27	F	66390	R	anterior	INTACT	R	Intact	Intact	Intact	3	2	28.3	14.3	CM, TYPE 1 Tym	Granulation	R CP	21.3	15	20	15.3
138	Poolammal	37	F	68862	R	PSR	INTACT	R	Tip of Handle eroded	Long process eroded	Suprastructure eroded	5	6	31.3	16	MRM, M reshaped between footplate and neo TM	INTACT	INTACT	30.3	15.3	26	15
139	Lakshmi	55	F	68274	L	INTACT	CP	L	Intact	Intact	Intact	4	5	16	44.6	CM, TYPE 1 Tym	INTACT	INTACT	16	24.6	16.3	22.3
140	Sheik Mydeen	40	M	68298	L	INTACT	posterior	L	Intact	Long process eroded	Intact	5	5	16	54	CM, I reshaped and kept bet M and SS	INTACT	INTACT	16	38	14.6	26.3
141	Ponrani	28	F	70350	B/L	CP	CP	L	Intact	Intact	Intact	2	2	36.3	44.3	CM, TYPE 1 Tym	INTACT	INTACT	36	32	34.6	26.6
142	Soumya	11	F	70359	B/L	PSR	posterior	R	Head and handle eroded	Completely eroded	Suprastructure eroded	5	4	35	37.3	MRM, Type 4 Tym	INTACT	Reinfection	32	36.6	25	36.3
143	Muthupappa	42	F	69400	R	posterior	INTACT	R	Intact	Intact	Intact	1	1	38	13.3	CM, TYPE 1 Tym	INTACT	R CP	26	15	28.3	15.3
144	Saravanan	45	M	71151	R	CP	INTACT	R	Intact	Intact	Intact	3	3	44.3	18.6	CM, TYPE 1 Tym	A	A	A	A	A	A
145	Subbulekshmi	25	F	72198	R	ST	INTACT	R	Intact	Intact	Intact	3	4	32	18.3	CM, TYPE 1 Tym	INTACT	INTACT	26.3	16.6	24	16.3
146	Sanmathi	19	F	73201	L	INTACT	ST	L	Intact	Intact	Intact	1	1	14.6	44.3	CM, TYPE 1 Tym	INTACT	INTACT	14.6	24	14.3	21.3
147	kumar	32	M	73609	R	ST	INTACT	R	Intact	Intact	Intact	1	1	38	21.3	CM, TYPE 1 Tym	A	A	A	A	A	A
148	Abdul Jaffer Sithick	25	M	74870	B/L	ST	ST	R	Intact	Intact	Intact	1	1	38.3	36.3	CM, TYPE 1 Tym	INTACT	INTACT	28.6	36	24	38.3

149	Muthumalanterior	35	M	58887	R	posterior	INTACT	R	Intact	Intact	Intact	1	1	26	16.6	CM, TYPE 1 Tym	INTACT	INTACT	22	16.6	21.3	18
150	Babu	41	M	59471	B/L	ST	posterior	R	Handle eroded	Long process eroded	Intact	8	6	44	28.3	CM, I reshaped between SS and neo TM	INTACT	INTACT	38.3	28.3	32	31
151	Maheshkumar	22	M	60598	R	CP	INTACT	R	Intact	Intact	Intact	1	1	29.3	14	CM, TYPE 1 Tym	A	A	A	A	A	A
152	Paulraj	20	M	62057`	L	INTACT	ST	L	Intact	Intact	Intact	1	1	15.3	34.3	CM, TYPE 1 Tym	INTACT	INTACT	15.3	26	15	28.6
153	Arulmary	18	F	65634	R	posterior	INTACT	R	Intact	Long process eroded	Intact	4	4	27	13	CM, I reshaped and kept bet M and SS	INTACT	INTACT	27	14.3	23	14.6
154	Sumathi	33	F	65616	R	ST	INTACT	R	Intact	Intact	Intact	2	4	47.3	21.3	CM, TYPE 1 Tym	A	A	A	A	A	A
155	Manojkumar	18	M	66196	R	anterior	INTACT	R	intact	Intact	Intact	1	1	28.6	14	CM, TYPE 1 Tym	INTACT	INTACT	22	15	21.3	15.6
156	Navneeth Krishnan	17	M	65069	L	INTACT	ST	L	Intact	Intact	Intact	1	1	16.6	46	CM, TYPE 1 Tym	INTACT	INTACT	16	28	18.3	22.6
157	Gnananteriorelvi	29	F	68614	R	ST	INTACT	R	Intact	Intact	Intact	1	1	31.3	14.6	CM, TYPE 1 Tym	INTACT	INTACT	26.3	16	26.3	16.3
158	Sajithabeevi	47	F	68613	R	anterior	INTACT	R	Intact	Long process eroded	Intact	5	4	38.6	17.3	CM, I reshaped and kept bet M and SS	INTACT	INTACT	36.3	16.6	28	17
159	Rajakumari	20	M	39813	B/L	ST	CP	R	Intact	Intact	Intact	1	1	38	31	CM, TYPE 1 Tym	INTACT	INTACT	26.3	31	28.6	31.3
160	Jeya	20	F	70608	R	posterior	INTACT	R	Intact	Long process eroded	Intact	4	4	41.6	21.6	CM, I reshaped and kept bet M and SS	INTACT	INTACT	46	21.3	42.3	21.6
161	Essakiammal	22	F	71450	R	CP	INTACT	R	Intact	Intact	Intact	1	1	36	17.3	CM, TYPE 1 Tym	INTACT	INTACT	21	17.3	18.6	15.3
162	Esther	40	F	71480	R	anterior	INTACT	R	Intact	Intact	Intact	1	1	28.3	15.6	CM, TYPE 1 Tym	INTACT	INTACT	28	16	26.6	16.3
163	Iyyappan	19	M	71972	R	GRADE 4 RET	INTACT	R	Handle eroded	Long process eroded	Suprastructure eroded	5	3	31.3	17.6	CM, M reshaped between footplate and neo TM, Conchal C over M	INTACT	Granulation	36	15	34.3	15.3
164	Meera	35	F	74692	R	ST	INTACT	R	Intact	Intact	Intact	1	1	38.6	36.3	CM, TYPE 1 Tym	A	A	A	A	A	A

Annexure 4

PROFORMA

Case No :

Name :

Age/Sex :

IP No :

Occupation :

Address :

Contact Number :

Chief Complaints

History of presenting illness

Past History

Personal History

Family History

Menstrual History

General Examination

Pulse rate

BP

Local examination

EAR **LEFT**

RIGHT

Pinna

Pre-auricular region

Post auricular region

EAC

Tympanic membrane

Mastoild tenderness

Fistula test

Tuning Fork test

Rinnie

Weber

ABC

Facial nerve

Vestibular function

Other findings

NOSE

ORAL CAVITY AND OROPHARYNX

NECK

SYSTEMIC EXAMINATION

CVS

RS

CNS

ABDOMEN

DIAGNOSIS

PRE OP AUDIOGRAM

Rt

PEROPERATIVE FINDING

OSSICULAR RECONSTRUCTION

POST OP AUDIOGRAM Rt Ear Left Year

3 months

6 months

Annexure 5

Table 1. *Middle ear risk index (MERI) scores (10)*

Risk factor	Risk value	Score
MIDDLE EAR FACTORS		
Otorrhoea		
I : Dry	0	
II. Occasionally wet	1	
III. Persistently wet	2	
IV: Wet, cleft palate	3	
Perforation		
Absent	0	
Present	1	
Cholestreatoma		
O : M + I + S +	0	
A : M + S +	1	
B : M + S -	2	
C : M – S +	3	
D : M – S -	4	
E : Ossicle head fixation	2	
F : Stapes fixation	3	
Middle ear : granulations or effusion		
No	0	
Yes	1	
Previous surgery		
None	0	
Staged	1	
Revision	2	

Table 2. ***Ossiloplasty outcome parameter staging index***

Risk factor	Risk value	Score
MIDDLE EAR FACTORS		
Drainage		
None	0	
Present >50% of time	1	
Muscosa		
Normal	0	
Fibrotic	2	
Ossicles		
Normal	0	
Malleus +	1	
Malleus +	2	
SURGICAL FACTORS		
Type of Surgery		
No mastoidectomy	0	
Canal-wall-up mastoidectomy	1	
Canal-wall-down mastoidectomy	2	
Revision surgery		
No	0	
Yes	2	